ASSESSING THE TOTAL ECONOMIC VALUE OF A WETLAND: A CASE STUDY OF BASAI

Thesis Submitted for the Award of the Degree of

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in

Geography

By

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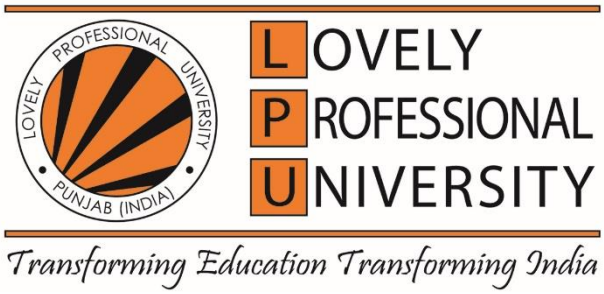

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DECLARATION

I, **VIPIN SOLANKI** hereby affirm that thesis, entitled **"Assessing the Total Economic Value of a Wetland: A Case Study of Basai"** submitted for the degree of **Doctor of Philosophy (Ph.D.)** is the result of my own research work and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree or diploma at this university or any other institution, except where due acknowledgement has been made in the thesis. .

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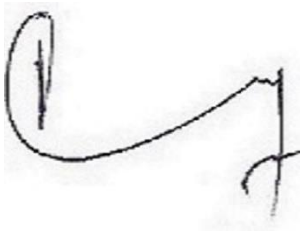
CERTIFICATE

This is certified that this work entitled **"Assessing the Total Economic Value of a Wetland: A Case Study of Basai"** is the original research carried out by **Mr Vipin Solanki (Registration No. 11719329)**, Ph.D. Research Scholar in **Department of Geography**, Lovely Professional University, Punjab. This work has been carried out under our supervision and has not been submitted anywhere else and is being submitted for the first time to the Lovely Professional University. The candidate has fulfilled all the statutory requirements for the submission of the Ph.D. thesis.



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ABSTRACT

Wetlands, recognized as an important integral part of an ecosystem, provide a multitude of services and benefits ranging from socio-cultural, economic, ecological and environmental. Wetlands are the source of drinking water, erosion control, crop production, flood control, climate stabilizers, ground water recharge, purification of the water and detoxification.

Wetlands are also an important part of a healthy environment. They help store water in dry periods and therefore keep the water table high and comparatively stable. At the time of flooding, they reduce the flood side by side and trap suspended nutrients and solids in lakes as if they were flowing directly into lakes. The removal of such wetland systems through urbanization or other factors generally leads to a deterioration of the lake's water quality. Additionally, wetlands are important feeding, breeding and drinking areas for wild animals and offer waterfowl a resting place and refuge. Like any natural habitat, wetlands are important for promoting biodiversity and have a complex and important food web. The most recent ecosystem assessment of the millennium identifies freshwater biodiversity as the most threatened of all biodiversity species.

These wetland values are increasingly exposed to various anthropogenic pressures. Rapid human population growth, large-scale changes in land use/land cover and flourishing development projects, as well as inappropriate use of water catchment areas, have resulted in a significant decline of the country's wetland resources. The lack of reliable and up-to-date information and data on the extent of wetlands, their conservation value, and their socio-economic importance has severely hampered the development of policies, legislation and state administrative intervention.

Increasing urbanisation pose great challenges for city planners as, along with ensuring delivery of basic amenities to people, they have to plan environmental sustainability also. Given the condition, urban wetlands have assumed immense importance in present times. Urban wetlands supply cities with water and green spaces for recreation which helps to promote human wellbeing. However, these ecological spaces are under the constant threat of being consumed under the expanding built-up area of the cities. As the land value increases, the ecological benefit of these spaces is undermined. Day by day the existence of these wetlands is in danger, hence, there is a need to protect, conserve and sustainably manage these natural resources for better use.

From 31st October to 12th of November, 2021 COP26 was held at Glasgow, Scotland which hosted by the United Kingdom in collaboration with Italy. Though it had to be held in 2020 but due to COVID-19, it was postponed. The major agenda of COP26 was Global warming and controlling the carbon emissions for which the participating nations pledged to achieve the net-zero aim (COP26, 2021). Carbon emissions from developed and developing countries are the major source of the global temperature rise. The net-zero term means balancing the emission of carbon by the absorption of carbon. Increasing the carbon sinks or carbon sequestration is the main area every nation need to focus on. For controlling the emission of carbon, wetlands play a very important role because of their carbon-absorbing capacity.

While wetlands are important for ecosystem services and human survival, they are also responsible for regulating a place's economy. Wetlands are an ecosystem that provides a host of economically valuable goods and services, not only to the locals who live in their area but also to the communities that live outside the wetland. Direct benefits of wetlands include bathing livestock, fishing, aquaculture and, most importantly, groundwater recharge that promote plant growth. These benefits help in increasing the economic growth of the regions where the wetlands are located. In addition, there are many indirect benefits of wetlands, especially carbon sequestration, through which wetlands absorb carbon from the atmosphere and maintain the proportion of gases, which is indirectly beneficial for human health by stabilizing oxygen levels.

A variety of techniques and methods have been invented to find out the economic value of the wetlands around the world. These economic values show the monetary benefit of the wetlands and aware people for conserving them. This thesis is an attempt to know the economic value of the Basai wetland, an urban man-made wetland located between sectors 101 and 102 of HSVP colony in Gurugram city of Haryana, India.

This thesis includes four objectives which aimed at finding the economic value of Basai wetland, Gurugram, India. The objectives are as follows:

1. To identify direct and indirect benefits of Basai wetland due to its existence to various stakeholders.
2. To find out the Total Economic Value of Basai wetland based on use values and non-use values.
3. To find out the temporal land-use changes based on Remote sensing data.

4. To find out appropriate measures for proper conservation of the wetland.

The first objective was to identify the direct and indirect benefit of Basai wetland and to accomplish this object Contingent Valuation Method (CVM) was used. CVM was a questionnaire-based valuation technique in which people perception was analysed and willingness to pay was calculated. The structured questionnaire was framed and a scheduled method was used to fill the questionnaire from Basai and Dhanwapur villages which are adjacent to Basai wetland. The questionnaire was divided into three sections, the first section dealt with the demography of respondents, the second section aimed at knowing the people's perception of the environment and the last third section was focussed on finding the people's willingness to pay for the conservation and management of the Basai wetland. The total mean willingness to pay was estimated at Rs 832 which is a good amount for urban wetlands as has been found from various studies analysed in literature reviews.

The second objective was to find out the Total Economic Value of Basai wetland based on use values and non-use values. The first part of the data source for calculating the total economic valuation of the Basai wetland was done in chapter 2 by Contingent Valuation Method (CVM). The final part of the data source was calculated in this chapter by Hedonic Pricing Method (HPM). The Non-Use Value was calculated by Hedonic Pricing Method (HPM) and then both CVM and HPM values were used for finding the final Total Economic Value of the Basai Wetland. The analysis showed that an increase of 1 meter further away from the Basai wetland decreased the total house price by Rs 645 which could be considered as a high impact. In all, we can say that the ecosystem services showed a positive impact on house price and, hence, it is also an important part of the city's development. The Total Economic Value of the Basai wetland (calculated by adding the value of CVM and HPM) was calculated to be Rs. 1477 which is very high as understood by the analysis and findings of different literature reviews.

The third objective was to find out the temporal land-use changes based on remote sensing data. This objective was an attempt to study the LULC (land use/land cover) of Basai wetland from 2010 to 2020. Basai receives water supply from a breached water channel which brings waste water and treated sewage from the Gurugram Water and Sewage Works. Basai provides habitat to about 240 bird species along with other aquatic fauna and is one of the Important Bird Area (IBA) of Haryana. However, the existence of this wetland is threatened on account of apathy of the State

government for not notifying this area as a wetland. To make the things worse, the state government had given clearance for the construction of a waste management plant along its periphery. This study investigated the temporal LULC (land-use/land cover) changes of this wetland based on GeoEye-1 satellite images for the years 2010, 2012, 2014, 2016, 2018 and 2020 which had been processed and analysed using GIS software (Arc GIS 10.4). It was found that over the last 10 years (from 2010 to 2020) major LU/LC changes were recorded in the Basai wetland. A major change was recorded in the built-up area which had increased approximately by 445% from 2010 to 2020 leading to the reduction in the Basai wetland area. The water bodies of the wetland showed a decline of 12.22% along with other changes such as increased growth of water hyacinth by 13.25%, increase in the fallow land by 30% and the development of roads under the 2nd Gurugram-Manesar master plan which were collectively responsible for the deterioration of this wetland.

Lastly, a measure was suggested to make a proper law for the management and conservation of wetlands which comes under the ambit of International Criminal Court and a new term "**Wetcide**" was introduced for creating its global importance. The crimes against wetlands such as throwing garbage, illegal fishing, illegal encroachments by the locals and industries, etc., should come under criminal offence and proper punishment by imposing fines and/or imprisonment should be given. These strict laws are the only possible way to tackle the emissions of greenhouse gases and to address the issue of climate change by restricting the increase of global average temperature up to 1.5 degrees Celsius as agreed by the United Nations member countries during the Paris agreement.

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LIST OF ABBREVIATIONS

EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization
PES	Payment of Ecosystem Services
NCR	National Capital Region
pH	potential of hydrogen
DO	Dissolved Oxygen
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CVM	Contingent Valuation Method
LULC	Land Use/Land Cover
TEV	Total Economic Value
ALOS	Advanced Land Observation Satellite
AVNIR	Advanced Visible and Near Infrared Radiometer
LDCs	Least developed countries
GIS	Geographic Information System
SCI	Science Citation Index
CWs	Constructed wetlands
WCAP	Wetlands Conservation Action Plan
GLWD	Global Lake and Wetlands Database
PSCST	Punjab State Council for Science and Technology
HPM	Hedonic Pricing Method
TVM	Travel Cost Method
NFI	Net Factor Income
IBAs	Important Bird Areas
ENVIS	Environmental Information System
NGT	National Green Tribunal
MCG	Municipal Corporation of Gurugram
C&D	Construction and Demolition
MoEF &CC	Ministry of Environment, Forest and Climate Change
DBF	Delhi Bird Foundation
HSVP	Haryana Shahari Vikas Pradhikaran
IBCN	Indian Bird Conservation Network
RAND	Research and Development
NESAC	North Eastern Space Applications Centre
ICAR	Indian Council of Agricultural Research
WTP	Willingness to Pay
MoHUA	Ministry of Housing and Urban Affairs
DEE	Department of the Environment and Energy

KMO	Kaiser-Meyer-Olkin
ML	Maximum Likelihood
BNHS	Bombay Natural History Society
GPS	Global Positioning System
GCP	Ground Control Points
IUCN	International Union for Conservation of Nature
SCC	Social Cost of carbon
ICC	International Criminal Court

CHAPTER 1

WETLANDS AND THEIR FUNCTIONS

1.1 INTRODUCTION

Human life from the very beginning depended upon the water. The early civilisations had started near the rivers, small ponds and lakes as these were the places for habitation and food. These lakes and ponds were later called wetlands and became the most important part of life for survival. At some times, small rivers and streams were also taken as sub-part of wetlands as they are considered the areas of accumulation of water on land in which water is a dominant feature. Wetlands are part of the hydrological cycle and are also the source of fresh water. To support livelihood and economic benefit, wetlands provide goods and services for human well-being. Aquatic animals, birds and aquatic plants rely on wetlands for their survival and simultaneously are an important part of an ecosystem. (FAO, 2011).

Wetlands are a vital part of the welfare of mankind which includes economic development and climate control/management, agriculture activities and consumption of water for drinking are provided directly or indirectly by wetlands. They shield our sea coasts and make human settlement and urban households safe and make strong enough to deal with upcoming many disasters. Globally Wetlands act as the greatest natural carbon sequester which directly affects the social cost of carbon (Social cost of carbon is an estimation of how much money our society will need to pay in the future to fix the damage caused by emitting one ton carbon dioxide today (Backman, 2021)) and gives economic strength to the place where wetlands exist. Wetlands are having a unique ecosystem that helps to support biodiversity. They help to mitigate climate change and provide sustainable livelihood and are vital for human wellbeing (EPA, Wetland Functions and Values, 2021).

The conservation of wetlands was already discussed globally in different conferences with respect to climate change. From 31st October to 12th of November, 2021 COP26 was held at Glasgow, Scotland hosted by the United Kingdom in collaboration with Italy which had to be held in 2020 but due to COVID-19, it was postponed and their major point of concern was Global warming and controlling the carbon emission and pledged to achieve the net-zero aim (COP26, 2021).

Carbon emissions from developed and developing countries are the major source of the global temperature rise. The net-zero term was introduced which means balancing the emission of carbon

by the absorption of carbon. Increasing the carbon sinks or carbon sequestration is the main thing every nation need to focus on. For controlling the emission of carbon, wetlands play the most important role because of their carbon-absorbing capacity i.e., carbon sequestration, wetlands absorb the carbon from the atmosphere and maintain the gases ratio which is indirectly helpful for stabilising the oxygen level.

There are so many definitions of wetlands that are given by many researchers and scientists but Ramsar Convention on wetlands definition is the desired one (EPA, Why are Wetlands Important?, 2021).

1.2 WETLAND DEFINITIONS

Convention on wetlands (Ramsar Iran, 1971) defines wetlands in Article 1.1. and 2.1

Article 1.1 states that wetlands are the "*area of marsh, fen, peatland of water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tides does not exceed six meters*" (Extraordinary, 2017).

Article 2.1 said that wetlands *'may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands.*

National Geography stated that "*A wetland is an area of land that is either covered by water or saturated with water*" (Evers, Jeannie;, 2020).

"*Wetlands are areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season*" by the United States Environmental Protection Agency (EPA, Wetlands, 2018)**.**

Cowardin & et,. al 1992 of U.S. Fish and Wildlife Services give the definition of wetland which stated that "*Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes;' (2) the substrate is predominantly*

undrained hydric soil; 2 and (3) the substrate is non soil and is saturated with water or covered by shallow water at some time during the growing season of each year".

These all definitions are given by respective organisations like the Ramsar Convention which is an intergovernmental body or government bodies from different countries to conserve or give international importance to wetlands. The economic significance of wetlands is also taken into consideration in recent times because these wetlands give endless opportunities for money generation by many recreational activities like boating, fishing, bird watching etc. People like to visit wetlands and spend time over there which make these wetlands fascinating, even many bird watchers or wildlife photographers used to visit there to take photographs and directly make these place full of treasure.

1.3 WETLANDS CLASSIFICATION

1.3.1 First Classification (Traditional)

There is two main approved classification for wetlands system that has attained wide acknowledgement. The first classification is a traditional one and the second classification is a scientific one. Cowardin and the co-workers of his team have developed the first classification in an organised hierarchical system. This classification distinguishes between "Wetlands" and "Deep water habitats" because generally wetlands were not included in the deep-water habitats. Then scientists started gaining the importance of wetlands and their classification become the major point of concern. Cowardin and his team classified the system into five major systems namely Marine, Estuarine, Riverine, Lacustrine, Palustrine which then further divided into sub-systems and subsystems into different classes (Cowardin & et. al, 1992)**.**

Table 1.1 Wetland and Deep-Water Habitat Classification for Marine & Estuarine

System	Sub-System	Classes
Marine	Subtidal	1.Rock Bottom
		2.Unconsolidated Bottom
		3.Aquatic Bed
		4.Reef
	Intertidal	1.Aquatic Bed
		2.Reef
		3.Rocky Shore
		4.Unconsolidated Shore
Estuarine	Subtidal	1.Rock Bottom
		2.Unconsolidated Bottom
		3.Aquatic Bed
		4.Reef
	Intertidal	1.Aquatic Bed
		2.Reef
		3.Streambed
		4.Rocky Shore
		5.Unconsolidated Shore
		6.Emergent Wetland
		7.Scrub-scrub Wetland
		8.Forested Wetland

Source: Cowardin et, al. 1992, Wetlands Types and Classifications (ceu.hu)

The first classification of wetlands given by Cowardin is about Marine in which there were two sub classes i.e., subtidal and intertidal in which aquatic bed and reef were common whereas rock bottom and unconsolidated bottom were only present in subtidal and rocky shore and the unconsolidated shore was present in intertidal sub-class of Marine wetland system.

The second classification of wetlands system was Estuarine and it is also having the same sub-classes as the Marine system of wetlands. Aquatic bed and reef are the common classes that were found in both the sub-classes of the Estuarine wetland system, whereas rock bottom and unconsolidated

bottom were only present in the subtidal sub-class. Streambed, rocky shore, unconsolidated shore, emergent wetland, scrub-scrub wetland, forested wetland come under the intertidal sub-class of the Estuarine wetland system.

Table 1.2 Wetland and Deep-Water Habitat Classification for Riverine, Lacustrine & Palustrine

System	Sub-System	Classes
Riverine	Tidal	1.Rock Bottom
		2.Unconsolidated Bottom
		3.Aquatic Bed
		4.Streambed
		5.Rocky Shore
		6.Unconsolidated Shore
		7.Emergent Wetland
	Lower Perennial	1.Unconsolidated Bottom
		2.Aquatic Bed
		3.Rocky Shore
		4.Unconsolidated Shore
		5.Emergent Wetland
	Upper Perennial	1.Rock Bottom
		2.Unconsolidated Bottom
		3.Aquatic Bed
		4.Rocky Shore
		5.Unconsolidated Shore
	Intermittent	1.Streambed
Lacustrine	Limnetic	1.Rock Bottom
		2.Unconsolidated Bottom
		3.Aquatic Bed
	Littoral	1.Rock Bottom
		2.Unconsolidated Bottom
		3.Aquatic Bed
		4.Rocky Shore
		5.Unconsolidated Shore
		6.Emergent Wetland
Palustrine		1.Rock Bottom
		2.Unconsolidated Bottom
		3.Aquatic Bed
		4.Unconsolidated Shore
		5.Moss-Lichen Wetland
		6.Emergent Wetland
		7.Scrub-scrub Wetland
		8.Forested Wetland

Source: Cowardin et, al. 1992, Wetlands Types and Classifications (ceu.hu).

The third system of wetlands was Riverine in which there were four sub-classes which are tidal, lower perennial, upper perennial, intermittent and total of eighteen classes. Rock bottom was present in tidal and upper perennial, unconsolidated bottom, aquatic bed, rocky shore and unconsolidated shore were present in tidal, lower perennial and upper perennial. The streambed was present in tidal and intermittent sub-classes only. The emergent wetland was present in tidal and upper perennial sub-classes.

The fourth system of wetlands under Cowardin was Lacustrine. In lacustrine, there were only two sub-classes i.e., limnetic and littoral. Rock bottom, unconsolidated bottom and aquatic bed were present in both the sub-classes whereas rocky shore, unconsolidated shore and emergent wetland were only present in the littoral sub-class.

The last system of wetland given by Cowardin was Palustrine. In palustrine, no sub-classes were depicted. Only eight classes were present i.e., rock bottom, unconsolidated bottom, aquatic bed, unconsolidated shore, moss-lichen wetland, emergent wetland, scrub-scrub wetland and forested wetland.

The main disadvantage of Cowardin and his worker's classification is that it did not mention many wetlands that emerged because of human activities and the reason for this disadvantage many wetlands remained unrecognised. This thesis is based on human-made wetland which is not mentioned in this classification.

1.3.2 Second Classification (Scientific)

The second wetland classification system was more scientific rather than traditional. In 1990 the convention on wetlands (Ramsar, Iran, 1971) developed a more exact and absolute classification of wetlands system which was later modified in the year 1996. This wetland classification system bypasses all the weaknesses of Cowardin et, al., classification. This classification is more precise and accurate and because of this classification, many wetlands were given recognition of international importance which further helps in their conservation and maintenance.

Table 1.3 Scientific classification for Marine/Coastal Wetlands

Marine/Coastal Wetlands	
A	Permanent shallow marine waters in most cases less than six metres deep at low tide; includes sea bays and straits.
B	Marine subtidal aquatic beds; includes kelp beds, sea-grass beds, tropical marine meadows.
C	Coral reefs.
D	Rocky marine shore; includes rocky offshore islands, sea cliffs.
E	Sand, shingle or pebble shores; includes sand bars, spits and sandy islets; includes dune systems and humid dune slacks.
F	Estuarine waters; permanent water of estuaries and estuarine systems of deltas.
G	Intertidal mud, sand or salt flats.
H	intertidal marshes; includes salt marshes, salt meadows, saltings, raised salt marshes; includes tidal brackish and freshwater marshes.
I	Intertidal forested wetlands; includes mangroves swamps, nipah swamps and tidal freshwater swamp forests.
J	Coastal brackish/saline lagoons; brackish to saline lagoons with at least one relatively narrow connection to the sea.
K	Coastal freshwater lagoons; includes freshwater delta lagoons.
Zk(a)	Karst and other subterranean hydrological systems, marine/coastal.

Source: Wetlands Types and Classifications (ceu.hu)

The marine and coastal wetlands ecosystem (Table 1.3) is the most productive ecosystem in the world still this ecosystem is facing many problems which lead to its degradation. One-third of the world's population lives near the coasts and they rely on the coastal ecosystem of wetlands or oceans. For the protection of this important wetland's ecosystem, scientific classification was made. The first scientific classification was given for marine/coastal wetlands by the Ramsar convention and approved by the recommendation of the conference of parties. This classification was done from the code 'A' to code 'K' and separately a code Zk(a). The coastal and marine wetlands of the world which can come under these different codes were classified as wetlands (Nature and Culture International, 2021) (Water and the Environment, 2021).

Table 1.4 Scientific classification for Inland Wetlands

Inland Wetlands	
L	Permanent inland deltas.
M	Permanent rivers/streams/creeks; includes waterfalls.
N	Seasonal/intermittent/irregular rivers/streams/creeks.
O	Permanent freshwater lakes (over 8ha); includes large oxbow lakes.
P	Seasonal/intermittent freshwater lakes (over 8ha); includes floodplain lakes.
Q	Permanent saline/brackish/alkaline lakes.
R	Seasonal/intermittent saline/brackish/alkaline lakes and flats.
Sp	Permanent saline/brackish/alkaline marshes/pools.
Ss	Seasonal/intermittent saline/brackish/alkaline marshes/pools.
Tp	Permanent freshwater marshes/pools; ponds (below 8ha), marshes and swamps on inorganic soils; with emergent vegetation water-logged for at least most of the growing season.
Ts	Seasonal/intermittent freshwater marshes/pools on inorganic soils; includes sloughs, potholes, seasonally flooded meadows, sedge marshes.
U	Non-forested peatlands; includes shrub or open bogs, swamps, fens.
Va	Alpine wetlands; includes alpine meadows, temporary waters from snowmelt.
Vt	Tundra wetlands; includes tundra pools, temporary waters from snowmelt.
W	Shrub-dominated wetlands; shrub swamps, shrub-dominated freshwater marshes, shrub carr, alder thicket on inorganic soils.
Xf	Freshwater, tree-dominated wetlands; includes freshwater swamp forests, seasonally flooded forests, wooded swamps on inorganic soils
Xp	Forested peatlands; peatswamp forests.
Y	Freshwater springs; oases.
Zg	Geothermal wetlands
Zk(b)	Karst and other subterranean hydrological systems, inland

Source: Wetlands Types and Classifications (ceu.hu)

The Inland wetlands (Table 1.4) are classified based on soil draining capacity. There are three characteristics for the inland wetlands i.e., poorly drained soil, very poorly drained soils and floodplains and alluvial. The poorly drained soil is defined as the soil where the water table is at or below the surface of the soil. Very poorly drained soil is defined as the soil where the water table is at or above the soil. Floodplains and alluvial are defined as the soil which is formed by the continuous deposition of floodwater and form a land by periodic flooding. The inland wetlands are occurring near the river streams, mashes etc. This inland wetland comes under the second scientific

classification. The codding was started from ‘L’ to ‘Z’ where for ‘S’, ‘P’, ‘V’ ‘X’ And ‘Z’ were having subcategories.

Table 1.5 Scientific classification for Human-made wetlands

Human-made wetlands	
1	Aquaculture (e.g., fish/shrimp) ponds
2	Ponds; includes farm ponds, stock ponds, small tanks; (generally below 8 ha).
3	Irrigated land; includes irrigation channels and rice fields:
4	Seasonally flooded agricultural land (including intensively managed or grazed wet meadow or pasture).
5	Salt exploitation sites; salt pans, salines, etc.
6	Water storage areas; reservoirs/barrages/dams/impoundments (generally over 8 ha).
7	Excavations; gravel/brick/clay pits; borrow pits, mining pools.
8	Wastewater treatment areas; sewage farms, settling ponds, oxidation basins, etc.
9	Canals and drainage channels, ditches
Zk©	Karst and other subterranean hydrological systems, human-made

Source: Wetlands Types and Classifications, 1996 (ceu.hu)

Any type of wetlands that are formed/constructed and maintained by Human beings were termed as Human Made wetlands examples are ponds, irrigated land, aquaculture or water storage reservoirs (UNEP, 2021). The human-made wetlands category was the third one in which coding of the wetlands was based on the number from 1 to 9 and a special coding was given by Zk©.

Basai wetland comes under Human-made wetlands (Table 1.5) which was formed by the stream that comes from a wastewater treatment plant. Category 8 under Human-made wetlands describe best for Basai wetland, which states that “wastewater treatment areas; sewage farms, settling ponds, oxidation basins etc. Basai wetland was flanked by Basai village which is in sector 9B to the south of Basai wetland and Dhanwapur village to the west.

1.4 CONVENTION ON WETLANDS

For the protection and conservation of wetlands throughout the world, a convention was held at Ramsar a small city of Iran in the year 1971. This was the first treaty of its kind which holds

international importance among the majority of nations aiming at conserving wetlands. The signing of the convention has happened at Ramsar city of Iran that's why it's is known as Ramsar Convention. The wide aims of the Ramsar Convention are to stop the wetlands loss globally and their protection with wise use management. For all these functions it requires strict policies, research, capacity building and the most prominent is international cooperation (Anonymous, 2020)**.**

Ramsar Convention includes different types of natural and man-made habitats classification extend from lakes, rivers to coral reefs that can be grouped as Wetlands. Wetland comprises any body of water whether temporary, permanent or artificial which include static or flowing, fresh or saline, brackish waters. Wetlands include river, marine or coastal water with a depth of 6 metres at low tide, there are some underground wetlands also.

Under Ramsar convention, in India there are 46 wetland sites are designated as international importance with a total area of 1083321.821 hectares. Out of a total, 28 states and 8 union territories, there are only 18 states and 2 union territories were having Ramsar sites of international importance. States like Uttar Pradesh is having the greatest number of Ramsar sites i.e., 7, followed by Punjab (6 Ramsar sites) and then Himachal Pradesh and Kerala both were having 4 Ramsar sites. 3 Ramsar sites are present in West Bengal, Gujarat and Maharashtra. Haryana, Odisha, and Rajasthan were having 2 Ramsar sites. Bihar, Assam, Andhra Pradesh, Tamil Nadu, Tripura, Uttarakhand were having only 1 Ramsar site. The Union Territories of Jammu & Kashmir were having 2 Ramsar sites and Ladakh with only 1 Ramsar site (Ramsar, INDIA, 2021)**.**

To designate a wetland under the Ramsar site of international importance one criterion should be followed by the said wetland out of a total of nine criteria presented in Table 1.6.

Table 1.6 Criterion for Ramsar Site Designation

Criterion	Definition
Group A	**Sites containing representative, rare or unique wetland types**
Criterion 1	A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.
Group B	**Sites of international importance for conserving biological diversity**
Criterion 2	A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.
Criterion 3	A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region
Criterion 4	A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.
Criterion 5	A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.
Criterion 6	A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.
Criterion 7	A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.
Criterion 8	A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.
Criterion 9	A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.

Source: Ramsar Convention, 1971.

1.5 FUNCTIONS OF WETLANDS

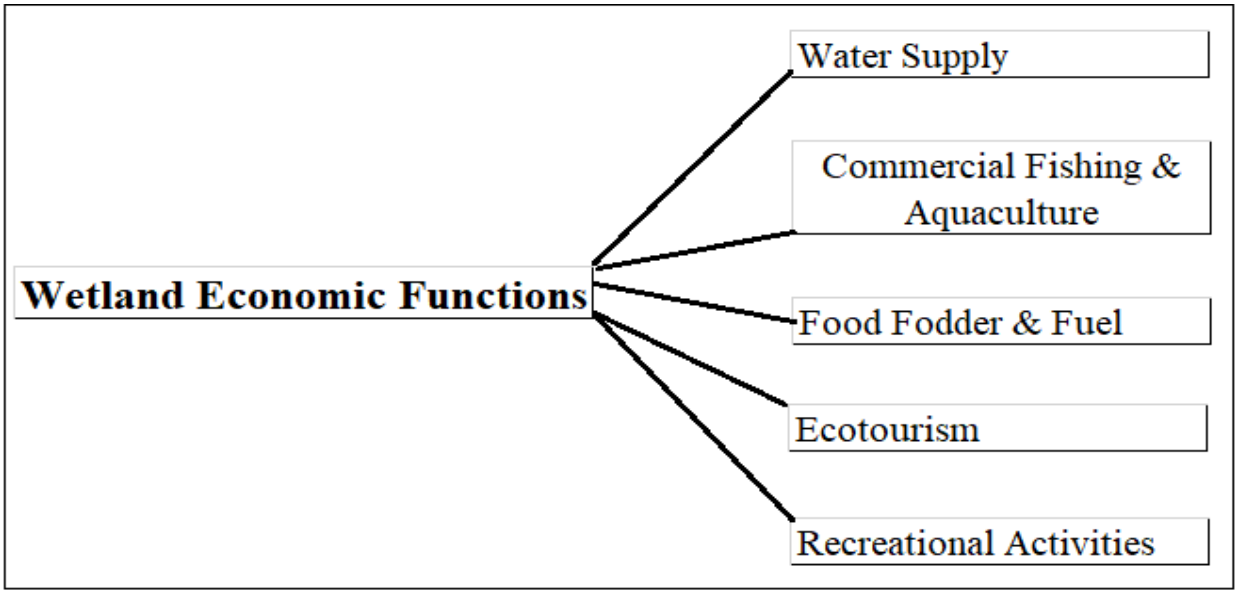
- The wetland ecosystem synchronizes ecological functions that give a healthy environment. Like as it recycles human excreta and nutrients and the protection of the watershed.
- Wetland ecosystems bring forth happening space for cultivation, human settlement, and energy transformation.

- The wetland ecosystem came up with resources for human utilization such as water, food, raw materials for the manufacture of goods and services.
- The wetland ecosystem provides information function by contributing to scientific, spiritual and aesthetic. The economic value provided by the wetland ecosystem that directly or indirectly put up the country's economic growth is also an example of an information function.

1.6 WETLANDS AND THEIR ECONOMIC RELATION

Wetlands are important for ecosystem services and the survival of human beings but also, they are responsible to regulate the economy of a place (IEEP, 2013). Wetland is an ecosystem that provides a large number of economically valuable commodities and services, not only for locals living in its surrounding areas but also for communities living outside the wetland area. Providing direct benefit by livestock bathing, fishing, aquaculture, and mainly groundwater recharge which will help for the crop growth. These categories will increase the economic growth of the region where wetlands exist. Many studies have been done for knowing the economic value of the wetlands (Barbier, Acreman, & Knowler, 1997) and some studies also show the payment method for using the wetland services. The multilevel model for knowing the economic value of urban wetlands is given by Turner R.K et al (1998). The Payment of Ecosystem Services (PES) is necessary for diverting the mind of mankind and gaining their interest in their preservation and conservation (Oliver Springate-Baginski , 2010).

Figure 1.1 Flow chart of Wetland Economic Functions



Wetland provides the water supply for flora and fauna which is the basic need for survival (Arya, Joshi, Bachheti, & Deepti, 2020). They also generate economy from aquaculture like from the coastal wetland of Gulf of Mexico in United States of America, generates nearly 8,277,649 USD alone in 2013 (National Ocean Service, 2021). 5 Per cent of GDP and approximately 6-7 per cent of world's jobs are produced by wetlands ecotourism and travel and this is for particularly coastal wetlands globally (Ramsar, Wetland tourism: a great experience, 2012). Recreational activities like birdwatching, photography or boating will create approximately 10 billion USD each year (Vermont, 2021). This study explains the total economic value of Basai wetland by knowing the use vale and non-use value.

Image 1.1 Commercial Fishing (Red Snapper) in the Gulf of Mexico

Source: (pewtrusts.org) (28th Aug 2019)

Image 1.2 Ecotourism in wetland

Source: Coronavirus and Ecotourism - The Tragic Intersection - SAPIENS (28th Aug 2019)

Image1.3 Recreational Activities (Boating & Photography)

Source: Wetland Functions and Values: Recreational Values and Economic Benefits | Department of Environmental Conservation (vermont.gov) (2021)

1.7 STUDY AREA

The Basai Wetland is situated in the sector 101 of Gurugram district of Haryana state. The geographic coordinates extension of Basai Wetland is 28°28'60'' North and 76°58'60'' East in Gurugram district of Haryana. Dhanwapur and Basai villages are adjacent to Basai wetland which are located in the 104th sector and 9B sector of Gurugram district of Haryana respectively

The total area of the Basai wetland is 312.06 Ha as this was taken by the report from Delhi Bird Foundation (DBF). It was formed by the water accumulated from the waste water treatment plant in Dhanwapur site and because of this it is also called as black water wetland.

Economically Basai Wetland is very important because it is adjacent to Dwarka expressway which comes under Gurugram-Manesar master plan 2025 (tcpharyana;, 2012) and due to this major goods and services movement was functioning along this route. Basai Wetland will be recharging the groundwater and save the city during a flash flood as most of the NCR region of New Delhi is already converted into a concrete jungle.

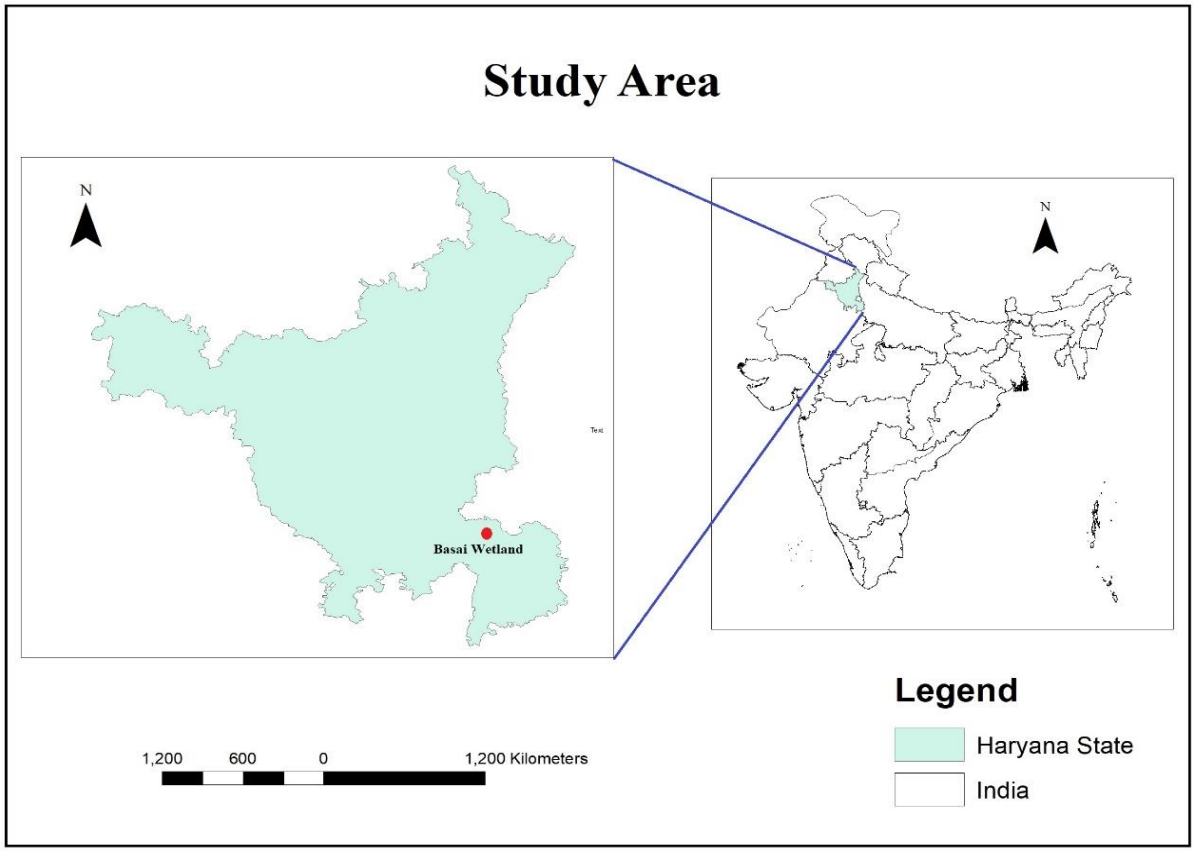
Gurugram is adjacent to the state of Delhi and is surrounded by Jhajjar, Rewari, Mewat, Palwal and Faridabad districts. It is both oval and slender in shape. The Gurugram District is located in the south-eastern part of the Haryana state, bordering Delhi to the north. Jhajjar district is located in the north-western part, Rewari district to the south-western part and Mewat district to the southern part, Palwal

district in the south-eastern part and Faridabad district in the eastern boundary of the district (Census, 2011). It is located between latitude 27°39`00″ North and latitude 28°32`25″ North and longitude 76°39` 30 East longitude 77°20` 45 East longitude. The geographical area is 1258.00 square kilometres, including 976.65 square kilometres in rural areas and 281.35 square kilometres in urban areas. The total population of Gurugram is 1514432. The total population growth rate of Gurugram is 79.93 per cent with an 84.4 per cent literacy rate and the city's sex ratio is 853 females per 1000 males (Census, 2011).

1.7.1 PHYSIOGRAPHY

There is a flexible plan which tends to change yearly and spread by extensions of Aravalli in the district of Gurugram. Aravalli ranges stretch throughout the western part of the district and add up to the region of National Capital, Delhi in the northeast. These Aravalli Mountain rocks were gone through extensive erosion over a long period and are termed as the oldest mountain range in the country. Physiography of the Gurugram district was subdivided into two sub-parts: Gurugram Plain and Sohna Undulating Plain with Aravalli spread. Gurugram Plain spreads over northern and north-western pieces of Gurugram tahsil and the entire Pataudi tahsil. The district in general is a plain region. The area is very homogeneous to the Sahibi Plain of Rewari locale. Sohna Undulating Plain with Aravalli branches stretches out over pieces of Sohna and Gurugram tahsils. The whole district is covered with rough surfaces of Aravalli Offshoots. These landforms make a progression of level beat edges. Just a few patches of land are under development. Due to offshoots of the Aravalli ranges, the region is undulating. There is little cultivation owing to rocky areas, poor soil cover and roughness of surface (Census, 2011).

Figure 1.4 Study Area Map



Source: Digitised in Arc GIS 10.4 software

Image 1.4 Location Map of Basai Wetland

Source: Google Earth Pro (2021)

Image 1.5 Basai village and Basai wetland

Source: Captured during field survey (March 13, 2018)

1.8 OBJECTIVES

The study aims to find the total economic value of the Basai Wetland ecosystem to sensitize the local community and policymakers for its effective management and conservation.

1. To identify direct and indirect benefits of Basai wetland due to its existence to various stakeholders.
2. To find out the Total Economic Value of Basai wetland based on use values and non-use values.
3. To find out the temporal land-use changes based on Remote sensing data.
4. To find out appropriate measures for the proper conservation of the wetland.

1.9 LITERATURE REVIEW

Malabika Biswas Roy et. al., (2019) in their paper entitled "Study of Conservation and Wise Use of Two Important Indian Wetlands Using Contingent Valuation Technique" analysis the Contingent Valuation method for Gajna wetland in West Bengal and Rudrasagar wetland in Tripura. The Contingent Valuation method was done by filling the questionnaire from the target population to

know their willingness to pay. The result of this research paper shows that the value for CVM in a rural household for both the wetlands was calculated INR 10,000 and INR 18,000. The CVM value is calculated by the willingness to pay for the conservation and management of the wetland services. The result also shows that willingness to pay is a great technique to analyse the monetary value of wetland services (Roy & et. al, 2019).

John C Whitehead (1990) in his research paper entitled "Measuring willingness-to-pay for wetlands preservation with the contingent valuation method (CVM)" stated that the preservation of lowland hardwood wetlands is threatened by pressure from the coal mining in Kentucky (USA) coalfield. The CVM method was used to measure the economic advantage (willingness to pay) of conserving Clear Creek Wetland, the largest wetland in the coalfield receives from open-air coal mining. The results showed that Kentucky households are willing to volunteer to pay between $6 and $13 to maintain a hypothetical Wetland Preservation Fund for conservation and maintenance. Reclamation of mines to replace conservation, recreational use of wetlands by respondents, conservation club membership, and age are determinants of willingness to pay. Clear Creek's total annual wetland conservation benefit is estimated at $ 2.94 million and estimated at $19 million, depending on general assumptions (Whitehead, 1990).

Woodward, Richard T and Wui, Yong-Suhk (2001) in their research paper entitled "The economic value of wetland services: a meta-analysis" describe that the value of wetland and its services provided to the ecosystem is increasing rapidly. Using 39 literature studies they evaluate the relative value of wetland services. The methods they use for valuing wetland are replacement cost (RC), travel cost method (TVM), contingent value method (CVM), hedonic pricing method (HPM) and net factor income (NFI) (Woodward & Wui, 2001).

Clive L. Spash (2000) in his research paper titled "Ecosystems, contingent valuation and ethics: The case of wetland re-creation" stated that a recent concern in natural valuation, specifically how much ecological inclinations digress from the standard financial model to oblige some lexicographical components. After a hypothetical conversation, work is made to research this inquiry exactly by enhancing unforeseen valuation strategy with an assessment of the purposes behind eagerness to pay, including void offers and refusals to react. This is trailed by the introduction of new proof looking at the readiness of respondents to pay for the formation of wetlands from 713 face-to-face interviews with the UK public. (Spash, 2000).

Harbans Singh (1997) in his research paper entitled "Contingent Value Measurement of Coastal Wetlands: A Case Study of New Jersey" said that the CVM for non-consumptive use of ecosystems is becoming an important tool in formulating strategies for upper reserve ecosystems, such as wetlands. A survey asked New Jerseyans how much they would be willing to contribute to the preservation and enhancement of coastal wetlands. The median contribution from three consecutive surveys in 1994, 95, 96 remained constant at $25.00. That number multiplied by the number of New Jersey households gave New Jersey wetlands a conditional valuation of $71 million. The survey results show that the contributions of respondents who visited wetlands are significantly higher; those who have a university education and who live in suburbs. Political changes have little impact on respondents' attitudes towards wetlands. 90 per cent of those surveyed said that wetlands should continue to be a zone for fish, shellfish, and wildlife; Coastal flood recovery and control. The high level of support for wetlands will help formulate policies for the conservation and protection of the wetland (Singh, 1997).

Clive L. Spash (2000) in his research paper titled "Ecosystems, contingent valuation and ethics: The case of wetland re-creation" stated that a recent concern in natural valuation, specifically how much ecological inclinations digress from the standard financial model to oblige some lexicographical components. After a hypothetical conversation, work is made to research this inquiry exactly by enhancing unforeseen valuation strategy with an assessment of the purposes behind eagerness to pay, including void offers and refusals to react. This is trailed by the introduction of new proof looking at the readiness of respondents to pay for the formation of wetlands from 713 face-to-face interviews with the UK public. (Spash, 2000).

Bennett, Jeff et. al., (1998) in their research paper entitled "Testing the validity of responses to contingent valuation questioning" reviewed most of the application of the Contingent Valuation Method in Australia. They concluded that the scope testing for CVM was not involved in the mixed results. The results also show that the environmental damage caused by dryland salinity was estimated by scope sensitivity and validity tests (Bennett & et.al., 1998).

P. Anoop, Suryaprakash S, Umesh B. K. and S. T. Babu Amjath (2008), in their study entitled 'Economic Valuation of Use Benefits of Ashtamudi Estuary in South India,' and said that according to the study the body of water could be a variety of wetland to produce the value of advantages by Ashtamudi body of water in south India. In these wetlands, the direct and indirect values take the

advantage of by the local people and the body of water is that the backbone to develop the higher method of living by the local people. It counsels that to require steps to conservation and property development however the wetland faces several issues just in case of pollution.

Emerton Lucy (2016), 'Economic Valuation of Wetlands,' according to the study the whole value is generally used for the wetlands economic benefits and additionally integrates for the choice creating. The below valuation of wetlands benefits TEV is employed to beat the issues with the facilitate of economic analysis and higher cognitive process. TEV of wetlands is relied on use values and not use-values. The employment values like direct worth, indirect worth and choice worth and additionally non-use worth like existence value (Emerton L. , 2016).

Brander Luke and Schuyt Kirsten, (2010), in their research paper entitled 'Benefits transfer: The Economic Value of world's wetlands,' and according to the study they enquired that the wetlands area unit found everywhere the globe. The matter within the wetland areas like pollution, overexploitation, natural resources consumption and land conversion, etc. wetlands provide numerous economic advantages in terms of direct use of values and indirect use of values. Wetland's area unit is the foremost vital scheme in the world and is the "Kidneys of the Landscape" (Brander & Schuyt, 2010).

Barbier, Edward.B (1993) in his research titled "Sustainable use of wetlands Valuing tropical wetland benefits: economic methodologies and applications" describes that the total number of tropical wetlands are increasingly disappearing due to an increase in development decisions. Development decisions directly exploit tropical wetlands by fishing, hunting, water supply and fuelwood extraction. The paper gives the method for assessing and valuing the economic benefits of a tropical wetland in direct and indirect ways by different methods like Contingent Valuation Method (CVM), Hedonic Pricing Methods (HPM) (Barbier E. , 1993).

Waddod Naimul Syed and Ali Ayub (2016), in their research paper entitled 'Economic Valuation of Rural Wetlands and Household Food Security: A case study from North-West Bangladesh,' said that according to the study wetlands in Asian countries play a very important role within the rural economy by tributary to domestic financial gain generation and food security of the close areas. In North-West region of Bangladesh has taken direct economic benefits for wetlands multiple uses.

Wetland provides numerous services for the poor section of the people in rural areas like mammal grazing and watering, fishing, life, and wetland plants (Wadood & Ali, 2016).

Lan Fang, Hao Wang, Yuan Yuan, Chaoya Wang, Sibo Wang and Tianyang Hu (2015), in their research paper entitled 'The Use and Non-Use Values of Ecosystem Services for Hechuan Wetland,' enquired that, according to the study Hechuan wetland is found within the mid-yellow stream within the China and its birthplace in Guanju. The wetland ecosystem provides the services to be used prices like direct use worth and indirect use worth and non-use worth as possible value or existence value. The authorities improve the wetland protection to require in the operating system and public transparency (Lan, et al., 2015).

Ramachandra, T.V. Rajnikant, R. Rajini, V.G (2005) in their research paper "Economic valuation of wetlands" discuss the valuation of wetland ecosystem by direct, indirect and existence benefits. Due to lack of knowledge, these economic valuations are often lost through inappropriate development about the vital functions performed by them. By knowing the economic valuation and economic benefits of wetlands, a step can formulate in the direction of making Wetlands Conservation Action Plan (WCAP) which can involve government and non-government organisations to establish a comprehensive wetland conservation programme.

Badamfirooz, J. Mousazadeh, R and Sarkheil, H (2021) in their research paper entitled "A proposed framework for economic valuation and assessment of damages cost to national wetlands ecosystem services using the benefit-transfer approach" stated that there is no proper valuation technique for the goods and services provided by the wetland in Iran. They had used the ecosystem services valuation database (ESVD) for the valuation of the coastal and inland wetlands of Iran. The results show that the mean of total wetlands valuation services for one year per hectares for both the coastal mangrove and inland wetlands was estimated to be approx. 67665 USD and 42171 USD respectively (Badamfirooz, Mousazadeh, & Sarkheil, 2021).

Mabwoga, Samson Okongo and Thukral, Ashwani Kumar, (2014) in their paper entitled "Characterization of change in the Harike wetland, a Ramsar site in India, using Landsat satellite data" by using remote sensing data shows that Harike wetland is degrading from land use. Rapid agriculture and anthropogenic impact affect this important Ramsar site and images from 1989, 2000

and 2010 years has been taken to prove that this wetland is in danger (Mabwoga, S.O; Thukral, A.K, 2014). 1

Mozumder, C., Tripathi, N. K., and Tipdecho, T., (2014) in their research paper entitled "Ecosystem evaluation (1989–2012) of Ramsar wetland Deepor Beel using satellite-derived indices" monitored the rule-based classification algorithm for Deepor Beel in the Assam state of India. The Different GIS-based classification was done using Landsat (2011) satellite, ALOS, AVNIR, google earth and field survey. The results show that for 23 years severe eutrophication and heavy changes in aquatic vegetation and the reason was related to anthropogenic activities (Mozumder & et.al, 2014).

Kashyap, Kangkana., Sahariah, Dhrubajyoti and Ghosh, Swagata (2018) in their research paper entitled "Monitoring Land Use/Land Cover Change and Consequent Effects on Wetland Environment-A Case Study of Deepor Beel, Assam, India" shows land use land cover transformation due to rapid urbanisation in the vicinity of the wetland. Multitemporal satellite images for 2003, 2008 and 2016 were used to classify the land use land cover maps which show a huge increase in the built-up area from 10.3 per cent in 2003 to 22.38 per cent in 2016. The maps also present a drastic decrease in the vegetation area from 24 per cent in 2003 to 17 per cent in 2016 (Kashyap, Sahariah, & Ghosh, 2018).

Romshoo, Shakil Ahmad and Rashid, Irfan (2012) in their paper titled "Assessing the impacts of changing land cover and climate on Hokersar wetland in Indian Himalayas" monitored the spatiotemporal changes of Himalayan Hokersar wetland from 1969 to 2008. The study shows that has there is a huge decrease in the area of wetland from 18.75 km^2 in 1969 to 13 km^2 in 2008. The main causes for the depleting wetland extent are urbanisation, changes in hydrologic and climatic conditions, deforestation and other land system changes (Romshoo & Rashid, 2012).

Kumar, Amit. Pandey, Puneeta (2013) in their research paper entitled "Assessing Spatial and Temporal Changes Using Remote Sensing and GIS in Harike Wetland, Punjab, India" describes that the 4200 hectares of Harike wetland which cover four districts of Punjab is very productive and helpful for water storage and groundwater recharge is bearing the brunt of population explosion and rapid industrialisation. Images of 29-03-2010 and 16-08-2013 were taken from Google Earth and used is Remote Sensing and GIS techniques i.e., ArcGIS for monitoring the spatial and temporal change (Kumar & Pandey, 2013).

Prerna Joshi, N. Siva Siddaiah and Arohi Dixit (2021) in their research paper entitled "Urban wetlands of Delhi, India: water quality and pollution status" said that the current research objects to comprehend the water quality of four urban wetlands of Delhi-NCR (Indira Gandhi stadium lake, Sanjay Lake, Okhla bird sanctuary and Bhalswa lake). Various surface water tests from these wetlands were determined in the colder time of year season and summer season for different physicochemical properties (temperature, pH, DO, BOD, COD, electrical conductivity, alkalinity, significant cations and anions) including the following metals. The consequence of the examination uncovers that the Water Quality Index shows that the water in all wetlands is poor or hazardous for drinking. Concerning the nature of water system water, the water from Lake Bhalswa is deficient, while the water from different wetlands is peripheral to sufficient. Both the nature of drinking water and water system water weaken in summer. Given the colossal environmental significance of these wetlands, critical measures are expected to end the crumbling of their well-being (Joshi, Siddaiah, & Dixit, 2021).

Korukoglu, Asuman et al. (2017) in their research paper "Evaluation of opinions related to the endangered Neopolis wetland in North Cyrus" describes the expectations and complaints of the common people living near Neopolis wetland which is an endangered area of international importance. The results of the research show that people are not aware of the importance of wetlands and they need picnic areas, local parks and beauty areas instead of protection of the wetland. They lack the knowledge of wetland ecosystems and their importance (Korukoglu & et al, 2017).

Z, ElZein. A, Abdou and I, Abd ElGawad (2016) in the research article entitled "Constructed wetlands as a Sustainable Wastewater Treatment Method in Communities" describes that in a country like Egypt water scarcity is a major problem and to overcome this 'Constructed wetlands' for wastewater treatment is a sustainable approach for the communities because they are convenient especially for developing countries (Z & et.al, 2016).

Amsalu, Tadessse. Addisu, Solomon (2014) in their paper "A review of Wetland Conservation and Management Policy in Ethiopian" describes due to lack of effective management the wetlands are degrading and converting into grazing land, agricultural land and also waste disposal sites. For protecting wetlands in Ethiopia government should adopt a National Wetland development policy and regional states should also adopt their regional policy to protect wetlands from degradation.

Bassi, Nitin et al (2014) in their research paper "Status of wetland in India: A review of extent, ecosystem benefits, threats and management strategies" describes that the wetlands are a crucial part of our society and provide a healthy ecosystem. This unique ecosystem is on the verge of shrinking day by day as no one is concerned about its importance. Anthropogenic pressure, pollution from industries, encroachment, and overexploitation of natural resources are the key factors for minimising the wetland area in the country. The research demands to work on socio-economic, physical and institutional factors which influence the wetlands (Bassi & et al, 2014).

G S Ogato (2013) in his research article entitled "The Human Ecology of Wetlands in the least Developed Countries in Time of Climate Change: Policy and Strategy Implications for Wise Use and Conservation of Wetlands" stated that wetlands are the most vital part of ecosystems on earth due to their unique hydrological conditions and their function as an ecotone between terrestrial and aquatic systems. Although several uses and values of wetlands are seen, historically wetlands have been regarded as wastelands that should be rehabilitated, wherever possible, into something else that is supplementary useful. The overall goal of the review is to survey the state of wetlands in LDCs during environmental change and to recognize political and vital effects. The consequences of the review affirm that the mix of variation and relief in reasonable turn of events and the endeavours of the most un-created nations (LDCs) to ensure normal assets are of most extreme significance for the preservation and manageable utilization of wetlands after some time of environmental change. In rundown, this survey affirmed that profound wetlands by and large retain carbon dioxide from the air and delivery methane into the air, and the blend of these two streams decides if these contradicting processes add to the general nursery impact of a wetland framework. Besides, both normal cycles and human exercises are answerable for the extended misfortunes of wetlands at all created nations. (Ogato, 2013).

Chopra, Girish. Tyor, Anil.K and Kumari, Seema (2012) in their research paper entitled "A Study on Wetland Avian Species of Sultanpur National Park Gurugram, Haryana (India)" says that wetland birds play an important role in human lives socially, scientifically and culturally. This study was held from February 2011 to January 2013, 79 species of birds belonging to 10 orders, 23 families and 57 genera were spotted in Sultanpur National Park.

Ramachandra, T.V (2012) in the paper titled "Conservation and Management of Wetlands: Requisite Strategies" shows a detailed account of the wetlands and their importance as they are synthesising

functions and nutrients as kidneys of the landscape. On special focus in Greater Bangalore Wetlands, research shows that urbanisation is the key source for the loss of lakes and led to a decrease in the catchment yield, water storage capacity, and the total number of migratory birds, wetland area and groundwater table. The land use analysis based on temporal change shows that there has been an increase of 632% built-up area from 1973 to 2009 which directly led to the decline of 79% area in water bodies in Greater Bangalore (Ramachandra T. , 2012).

Deka, Jyotishman. Tripathi, Om Prakash and Khan, Mohammad Latif (2011) in their research article entitled "A multi-temporal remote sensing approach for monitoring changes in the spatial extent of the freshwater lake of Deepor Beel Ramsar Site, a major wetland of Assam" shows that 'Deepor Beel' wetland of Assam was observed for the period of 20 years from 1991-2010 by remote sensing images taken from Landsat TM data. Observation shows that there is a massive decline in the wetland area as a result of rapid urbanisation, industrialisation, illegal settlements and invasive species (Eichhornia crassipes) (Deka & et.al, 2011).

Zhang, Liang. Wang, Ming-Huang. Hu, Jie. And Ho, Yuh-Shan (2010) in their article entitled "A review of published wetland research, 1991-2008: Ecological engineering and ecosystem restoration" had done a bibliometric analysis of the papers based on the Science Citation Index (SCI) published under the Institute of Scientific Information (ISI) for wetland from 1991 to 2008. The study shows that SCI has 16,871 publications in 16 documents were obtained for wetland research points from 1991-2008 and 99% of research were in English (Zhang & et.al, 2010).

Mabwoga, Samson Okongo. Chawla, Amit. Thukral, Ashwani Kumar (2009) in their research entitled "Assessment of water quality parameters of the Harike Wetland in India, a Ramsar site, using IRSS, LISS IV satellite data" shows the classification of water quality of Harike Wetland using Resourcesat (IRS P6) satellite and images from LISS IV multispectral sensor using three bands (green, red, near infrared (NIR)) with resolution 5.8m. Research shows that river Beas water is distinguishable from the water of river Sutlej based on Digital Number (DN) values taken from the sampling. There is a positive correlation for NIR (DN) values with turbidity and total solid for LISS IV data and also shows the negative correlation with secchi disk transparency (SDT) and the NIR DN values (Mabwoga, Chawla, & Thukral, 2009).

Bhattacharyya, A et al (2008) in their paper titled "A Critical Study on Status of East Kolkata Wetlands with Special Emphasis on Water Birds as Bio-Indicator" researched the declining numbers of water birds which act as a Bio-Indictor due to lack of niche, food and usage of heavy chemicals in agriculture and fisheries activities. They also use the Geographical Information System and Remote Sensing technique to collect the data and issues related to this wetland (Bhattacharyya & et.al, 2008).

Cooper, Paul (2008) in their paper entitled "What can we learn from old wetlands? Lessons that have been learned and some that may have been forgotten over the past 20 years" describes constructed wetlands (CWs) bed technique in Europe has gained a significant acceptance in the past 20 years for individual houses small groups of houses and the most common use is for treating domestic sewage from villages to achieve secondary treatment and it is still happening (Cooper, 2008).

Lehner, Bernhard. Doll, Petra (2004) in their research paper titled "Development and validation of a global database of lakes, reservoirs and wetlands" created a new Global Lake and Wetlands Database (GLWD). The generation of the database is created by the application of GIS which focuses on three coordinate's levels on 1. Large lakes and reservoirs 2. Smaller water bodies, and 3. wetlands. Level 1 comprises polygons of 3067 largest lakes and 654 largest reservoirs worldwide. Level 2 contribute shoreline polygons of water bodies of area ≥ 0.1 km^2 excluding level 1 water bodies and approx 250,000 polygons. Level 3 comprises reservoirs, lakes, rivers and wetlands in the form of a global raster map at 30 second resolution (Lehner & Doll, 2004).

Stottmeister, U et al (2003) in their paper entitled "Effects of plants and microorganisms in constructed wetlands for wastewater treatment" shows that the best natural alternative to the technical method of wastewater treatment is constructed wetlands. The plants in constructed wetlands and the root zone microorganisms can play the role of removing the contamination from wastewater (Stottmeister & et al, 2003).

Ladhar, Satnam Singh (2002) in his research paper entitled "Status of ecological health of wetlands in Punjab, India" shows that the total man-made and natural wetlands in Punjab covers an area of 23000 hectares which are under stress of general economic degradation. Though the protection and conservation of wetlands are in the eyes of the government the attitude of common people towards these wetlands are negative. Due to the continuous loss of natural wetlands in the state, the Punjab

State Council for Science and Technology (PSCST) identified five to be designated as wetlands of state significance (Ladhar, 2002).

Prasad, S.N et al (2002) in their research paper titled "Conservation of Wetlands of India- a review" stated that the total wetlands of India are estimated at 58.2 million hectares and are important aquatic biodiversity. This review deals with the distribution and the total status of Indian wetlands also their causes and consequences of losses with the use of Remote Sensing and Geographic Information System (GIS) by IRS LISS III sensors for delineating turbidity, aquatic vegetation etc. The mega country India needs to conserve their wetlands with the use of GIS tools (Prasad & et al, 2002).

Kivaisi, Amelia K (2001) in his paper titled "The potential for constructed wetlands for wastewater treatment and reuse in developing countries: a review" describes that recently the most effective technique proven for wastewater treatment is constructed wetlands in basically developing countries. Constructed wetlands are most cost-effective and are easily maintained and operated application. This low-cost technique has not been used widely due to a lack of knowledge and awareness in small rural communities in developing countries. This paper further shows the potential of constructed wetlands for wastewater treatment and reuse in different countries (Kivaisi, 2001).

Mitsch, J William and Gosselink, G James (2000) in their paper titled "The value of wetlands: importance of scale and landscape setting" describes that wetland provides functions that have values for human needs. The landscape spatially distributed system appears to be best for wetlands work. Somehow the value to wetlands depends on the landscape where they are found e.g., the degree to which wetland is open to biological fluxes and hydrologic with another system including agriculture landscape. In a hydrogeomorphic setting isolated basin wetland has a lower value as compared to riparian and flow through wetlands (Mitsch & Gosselink, 2000).

Turner, R Kerry et al (2000) in their paper entitled "Ecological-economic analysis of wetlands: scientific integration for management and policy" describes the loss and threat of wetlands all over the world even after having so many international and national policies. Public nature towards many wetlands goods and services and policy intervention failures due to lack of consistency among government policies are the main causes of wetland loss. Integrated wetland research of social and natural sciences can help in sustainable and welfare-optimising wetland management and policy (Turner & et al, 2000).

Foote A Lee. Pandey Sanjeeva and Krogman Naomi T (1996) in their paper entitled “Processes of Wetland loss in India” describe approximately 75 Per Cent of the Indian population are living in rural areas due to which wetland losses continue to occur. This research is based on an extensive literature search and covers a large area of discussions with government employees resource managers, farmers, and resource users at dozens of sites in India. The twelve main and important reasons for wetland loss are experienced and the mechanisms which cause them are also discussed. If wetlands have remained in function, public awareness must continue growing (Foote, Pandey, & Krogman , 1996).

Juwarkar, A.S et al (1995) in their research “Domestic Wastewater Treatment Through Constructed Wetlands in India” describe that constructed wetlands are a cost-effective alternative for removal of Biological Oxygen Demand (BOD), phosphorus, pathogens and nitrogen. The country first constructed wetland was installed in Sainik School of Bhubaneshwar in Orissa in which two types of macrophytes i.e Typha latifolia and Phragmities carca were planted and they show the result of removal of BOD at 78-91%, nitrogen content reduced from 30.8mgl^{-1} to 9.5mgl^{-1} (Juwarkar & et al, 1995).

Richardson, Curtis.J (1994) in his paper entitled “Ecological Functions and Human Values in Wetlands: A Framework for Assessing Forestry Impact” shows that the ‘Value’ term used for Homes sapiens also ascribed for Wetlands which include habitat for fishing, timber, wastewater assimilation, hunting, waterfowl, and flood control. Paper describes that overutilization of wetlands and intensive removal of wetland values can lead to loss of wetland functions (Richardson, 1994).

Jerath, Neelima et al in their paper titled “Enhancing Community Participation for Conservation of Wetlands” describe that Punjab has three Ramsar sites viz. Kanjli, Harike and Ropar all these wetlands provide habitat for diverse flora and fauna of some threatened plants and animals. The paper focuses on two things firstly the aware and local people about the conservation of sustainable use of wetland and secondly, they started the pilot project of making handicrafts from water hyacinth. The result shows that the local people were encouraging and frequently responded and took keen interest (Jerath & et al, 2014).

1.10 RATIONALE

Globally Delhi comes under top five polluted cities all over the world reported by the Swiss organisation IQAir and showed that Delhi has an average of 2.5 PM concentration of 84 ug/m3. (IDR, 2021) In the concrete jungle of Delhi and its NCR wetlands act as lungs for breathing space. Basai wetland which is in Gurugram, NCR gives special importance to overcoming the water pollution and air pollution problem, this shows a red alert for the government to focus and take immediate action to curb this menace. Flora and fauna should be preserved in urban Delhi and NCR to lower the pollution level. Preserving small spot wetlands near Delhi plays a big role to maintain the balance between man and nature. Basai wetland comes under Important Bird Areas (IBAs) site need to be preserved for the same by sensitizing local population and also the authorities (ENVIS, 2016).

The Basai wetland is a bird paradise and because of negligence and unsustainable development use, this place become the best example of environmental destruction and a threat to the plant and animal habitat.

The total number of birds species were spotted in the Basai wetland in the year 2015 was 320, however, this number was decreased to 240 in the year 2016 as per the data provided by the wildlife department (Pati, 2016). Asian dowitcher and European roller and Red-headed Vulture are among the 240 species seen in the area. The state bird of Haryana Black francolin and Flamingos were the most common birds found in Basai wetland once. The numbers of these birds are now decreasing day by day (Dhankhar, 2017). Individuals who know about this reality are quite worried about the declining bird's species here and show their profound distress to the way that this wetland, which was prior a bird's heaven and a major wellspring of groundwater re-energize, presently has limited to simply a patch of marshy land having only one sq. Km. of the region.

Sushir Singh Chauhan a senior town planner from Muncipal Corporation of Gurugram quoted that they would remove any kind of encroachment from the Basai wetlands and will investigate the issue but as of now they are not aware about any kind of encroachment (Pati, 2016).

1.11 SCOPE OF THE STUDY

Indian central government officially gave the significance of wetlands and frame specific rules in 2010 under the Environmental protection Act 1986. Under the wetland rule of 2017, it is defined as “an area on or of marsh, fen, peatland or water: natural or artificial, permanent or temporary, with water that is static or flowing, fresh brackish or salty areas of marine water, the depth of which at low

tides does not exceed six meters and including all inland waters such as lakes and reservoirs, tanks, backwaters lagoon, creek, estuaries and manmade wetland" (Ghosh, 2018).

The area of Basai has been decreasing for many years. Approximately 900 hectares in 2001 and had been reduced to 150 hectares in 2010, and keep on decreasing, percentage change is approximately 88% of area. The irrigation and water resources department of Haryana has submitted a list of 51 wetlands in the state of which, Gurugram district has only three 28.82 hectares in the Harsaru, 120.80 hectares in Kherki Majra Dhankot (Najafgarh lake), 153.96 hectares of Sultanpur lake (a bird sanctuary) (Arora, Shilpy. 2019). Basai was not on the list of wetlands having an area of 150 hectares and the government for their own sake did not give any significance to this wetland.

All these factors give light to take this topic to the national level and show the government that Basai is an important wetland and give this Basai as a "wetland" notification.

Gurugram is one of the greatest industrial centres in the Delhi NCR area and is likewise well known for the DLF digital city. Haryana government is selling plots here consistently which is a genuine danger encompassing the climate and in the wake of presenting the second Gurugram-Manesar master plan, the advancement level has additionally ascended which is going about as a termite for Basai Wetland as it is destroying the wetland via encroachments.

Basai had been disregarded however Sultanpur adores in the maintenance and conservation status because of its control by the forest department since the 1950s. Further, Basai rich biodiversity had confronted annihilation because of the huge scope of urbanization after the presentation of the second Gurugram-Manesar Master Plan, and presently is confronting the danger of vanishing (Chopra & et, al, 2012).

The underground water table is crucial to guarantee sufficient water supplies for the inhabitants of a city and a wetland is the significant wellspring of groundwater re-energize and keeping up with the hydrological balance. Thinking about this component, the Basai wetland is vital to a city like Gurugram which faces regular flooding and resultant traffic chaos pretty much in every rainy season (Mishra, 2018). Such open spaces give alleviation from waterlogging in these " concrete jungles ".

The significance of these wetlands in an over-populated city like Gurugram has likewise been recognized by Mr G.S. Bal, who is a specialist in disaster management from Amity University, Noida. The consistently expanding population and development of elevated structures/skyscrapers in the city are unfavourably influencing its underground water table. In such a situation these wetland plays many important functions like recharging groundwater by absorbing the rain and otherwise such a

metropolitan city will be affected by urban floods, as was observed in the case of Chennai, Tamil Nadu. (Arora, S, 2016)

Nowadays the wetlands in the India are diminishing (Sunkara & et al, 2001)and because of this an order was given by the National Green Tribunal (NGT) directed all state governments to confirm sustainable use of natural wetlands and preserve their existence (Pati, 2016). C&D (Construction and Demolition) waste plant was inaugurated by the Chief Minister of Haryana on 16th June 2017 on an area of 3.5 acres of Basai wetland, which was suggested by the Municipal Corporation of Gurugram (MCG). This C &D plant was about to treat nearly 500 tonnes of wastage every day and it was started in the starting month of 2018.

Image 1.6 C& D (construction and demolition) waste processing plant near Basai wetland

Source: Captured during field survey. (28th Jan 2021)

'Delhi Bird Foundation" an NGO from Delhi filed a complaint in the National Green Tribunal on June 22nd, 2017 against the Haryana State Government for approving the construction of C & D plant at the periphery of Basai wetland and not designation it as a 'Wetland'.

As expressed in the appeal, as per the C&D the board management rules 2016, a waste management plant can't be built along a wetland, national park, forest, water body or human settlement, and complaint also stated that Basai has not been designated as a wetland under the (Wetland and

Management) Rules 2017 regardless of having a rich avifauna and amphibian life. Responding to this, the Union Ministry of Environment, Forest and Climate Change (MoEF &CC) strongly asking answers from the Haryana government for not giving any notification to recognize and designate Basai as a wetland.

On 12th August 2017, 6 pictures showed to National Green Tribunal by Delhi based NGO, the Delhi Bird Foundation in which the total area of 900 acres of Basai wetland was presented and requested to stop the construction of C & D plant nearby Basai Wetland. These photographs were taken from Google images about one to two years back. The NGO said that Basai was a bird paradise and had a huge aquatic ecosystem (Arora, S, 2017).

The stopping of the breach in the water channel and extension of the housing project by Haryana Shahari Vikas Pradhikaran (HSVP) west of the railways can pose a serious threat to the Basai wetland. Moreover, there is a problem of shooting and trapping birds at night during winters (IBCN, 2015).

1.12 DATA SOURCE AND METHODOLOGY

The data source for the first and second objectives was done from a primary survey based on a structured questionnaire. Two questionnaires were framed, one questionnaire was prepared for knowing the Contingent valuation method to complete the first objective, and one questionnaire was made for knowing the Hedonic pricing method to complete the second objective. The schedule method was used for filling the questionnaire. For evaluating the result following equation was used:

Total Economic Value (TEV) = Use Value [Direct-use value + Indirect-use value +
Option value] + Non-use Value [Existence value + Bequest value + Philanthropy value]

For Use Value: -

Contingent Valuation Method- Willingness to pay for ecosystem services.

For Non-Use Value: -

Hedonic Pricing Method- Impact on land values, assuming that the wetland functions are fully reflected in land prices.

The data source for the third objective was taken from satellite imagery Geo eye 1, USGS earth explorer and google earth. Arc GIS 10.4 was used for analysing the satellite images. For the fourth objective secondary data was collected from different government websites and environmental

organisations. After that, it was observed and gives proper measures for conservation and management of wetlands.

The study will be based on non-Probability sampling techniques in which convenience sampling methods were used because of Covid-19 in the primary survey for collection of data from households of the study area which were done for two villages. The study will employ a mixed-method approach using both qualitative (The qualitative approach involves theory construction rather than theory testing) as well as quantitative techniques. For convenience sampling, the sample size would be 10% of the total number of households in each of the two selected localities i.e., Basai and Dhanwapur villages.

1.12.1 Delphi Method

Delphi strategy is an organized correspondence procedure. Initially created as a precise, intelligent anticipating strategy that depends on a board of specialists. The Delphi strategy was initially proposed dependent on individuals' judgment, and motivation however bit by bit took the scholarly structure. First time in the last part of the 1950s, in research by U.S. RAND Corporation, the Delphi was presented for the logical investigation of specialists' perspectives on a tactical protection project. First non-military use was proposed for financial advancement arranging. Following 10 years' time span, again in 1963, Dalkey and Helmer presented it and during the 1990s become well known. Specialists answer polls in at least two rounds. Likewise, the reasons they accommodated their decisions. Hence, specialists are urged to reconsider their prior replies considering the answers of different individuals from their board (RAND Corporation, 2021).

The persons from which the questionnaires were validated are as follows: -

- Dr. Kasturi Chakraborty
  Scientist
  North Eastern Space Applications Centre (NESAC), Meghalaya
- Dr. Bhaskar Phaneendra
  Principal Scientist
  PhD-Soil Science and Agricultural Chemistry
  Regional centre, Indian Council of Agricultural Research (ICAR)
- Dr Susan Abraham
  School Applied Economics,

Cochin University of Science and Technology

- Dr Pradip Sharma
  Associate Professor
  Department of Geography,
  Cotton University, Guwahati-781001

CHAPTER 2

CONTINGENT VALUATION MEASUREMENT OF BASAI WETLAND

2.1 INTRODUCTION

Nowadays Wetlands are threatened and facing a huge decline in their number all over the world mainly because of the encroachments by the human populations. Due to lack of knowledge about wetlands, humans think wetlands are the wastelands and spread only diseases but in real scenarios wetlands are the important source of groundwater recharge, fisheries, crop production etc.

Wetlands are the lungs of the ecosystem as they purify the atmosphere by carbon sequestration and slowly trap the water which further helps in controlling the floods in urban areas especially. Wetlands are very rich and have multiple benefits socially, culturally and economically to maintain the world's ecosystem.

Environmental resources such as wetlands are necessary for the existence of humans. Without the wise use of these resources, they will deplete and degrade and it will cause loss of human life. It is necessary to "Hold" these resources and use them wisely. For this their economic valuation is an essential estimation to assist in policy making (Barbier, Acreman, & Knowler, 1997).

There are multiple benefits given by the wetlands but still, their values are typically lost because of a lack of knowledge regarding the important functions carried out by them. The functions of the wetlands are deteriorating and their value going down due to the view wetlands as a free resource. The pricing of wetlands needs to be furnished to control the excessive use of wetlands by the people. To gain the maximum benefit with wise and sustainable management of the wetlands, many economic valuation techniques are widely applied.

The environmental products and resources assist us differently so we quantitively assign economic valuation to evaluate products and resources. In another way the real economic value of environmental products is not given, instead, it is measured on the public willingness to pay for the services generally used.

To help and work on the insightful use and the executives of wetland assets, financial valuation helps as an amazing asset for estimating and looking at the different advantages of wetlands (Barbier, Acreman, and Knowler, 1997). As far as financial matters, the worth of the advantage is for the most part controlled by its cost, i.e., the measure of cash for which it will be traded. The worth of an

advantage is the cost of that item in the open market and the value of that advantage to an expected purchaser. This is estimated in monetary terms as a willingness to pay. All in all, the monetary worth of the wetland administrations was estimated by individuals' willingness to pay (WTP) for those advantages. Henceforth, monetary valuation is a work to entrust quantitative qualities to the labour and products given by natural assets, regardless of whether market costs are accessible to help. Likewise, the monetary valuation is an evaluation of the ecological goods and products, and the concern of individuals for the climate (Ramachandra, Rajinikanth, & Ranjini, 2005).

The Millennium Ecosystem Assessment (2003) defined value as "The contribution of an action or object to user-specified goals, objectives, or conditions" (Farber et al. 2002). The use-value is termed as the direct use of wetland goods and services for example the water of the wetland used for livestock bathing, irrigation of crops, aquaculture etc. Some other direct uses of the wetlands are fishing, boating or recreational activities. The subpart of the use-value is option value which is done by the Contingent Valuation Method (CVM).

Opportunities from ecotourism, charming beauty, hydrological functions, habitat for flora and fauna population all these environmental services and good are given by wetlands which are not traded in the daily market. Due to the lack of a well-organized market for these resources, many economic valuation methods have been developed for the valuation of unmarked goods. The most prominent and widely used among these techniques is the Contingent valuation method. (CVM) (Siew & et al, 2015).

As discussed, the valuation is a pre-condition for knowing the economic importance of the wetland. This chapter deals with the direct and indirect benefits of the wetlands through the Contingent Valuation Method (CVM). The CVM is the most commonly used method for evaluating the use-value of a wetland for estimating the change in the supply of non-market goods. The CVM is a household survey-based methodology to estimate the direct and indirect benefits of a wetland which depend on finding the monetary benefit of the environmental goods which is not traded in conventional markets. These monetary estimations of environmental goods are obtained as an individual's Willingness to Pay (WTP).

2.2 SAMPLING AND SURVEY METHOD

Two villages adjacent to Basai wetland were taken for filling the structured questionnaire, first village was Basai which was in the 9B sector and the second village was Dhanwapur which was in the 104th

sector of Gurugram district of Haryana. A pilot survey with 50 questionnaires has been done in November 2020 for checking the reasonability and understandability of the questionnaire. The main survey was conducted from December 2020 to January 2021. For data collection, a schedule method was incorporated for a set of questions. convenience sampling was done for 125 households each from Basai and Dhanwapur. The questionnaire was divided into three sections, the section first was comprised of the demography of the respondents, the second section was the respondent perception and the third section was for Willingness to Pay (WTP) for the wetland resources. In making a contingent valuation (CV) survey, a situation should offer respondents information about the features of the specific good and a context, which meets the requirements of understandability, credibility and meaningfulness so that it can enhance the trustworthiness of a survey, and make it more likely to produce authentic results. The questions were explained to every respondent clearly for knowing their perception and their point of view regarding the Basai wetland environment. After the survey, all questionnaires were checked. Questionnaires with errors and contradictory responses were removed and fresh questionnaires were filled with the new respondents.

Image 2.1: Depicts fishing by locals and by using fishing nets in Basai Wetland

Source: Captured during field survey. (March 12, 2018)

Image 2.2: Depicts livestock bathing and high rise building near Basai Wetland

Source: Captured during field survey. (March 12, 2018)

2.3 SURVEY DEVELOPMENT AND SURVEY STRUCTURE

Before asking the willingness to pay questions, an effort was done through the questions to construct an image of the wetland to show its importance as an environmental function. Two situations were explained to the respondents. According to that the advantages and disadvantages of the Basai wetland were discussed if the wetland will remain at the present condition or it should come under wetland conservation and management rule 2017. The following is the set of situations:

"

Situation A: State of the Basai Wetland ecosystem and its delivery of services in 2019 if current environment management remains the same.	**Situation B**: State of the Basai Wetland ecosystem and its delivery of services in 2019 if managed by a Wetlands (Conservation and Management) Rules, 2017, India
1.A Household/Industrial Waste dissemination function ▪ Congested water channel ▪ Accumulated waste ▪ Contamination of water ▪ Spread of communicative diseases via Mosquitoes. ▪ Non degradable plastic and industrial pollutants ▪ Increased pollution	1.B Household / Industrial Waste dissemination function ▪ Cleaner water channels & canals ▪ Prompt disposal of wastes ▪ Good water quality ▪ Free from communicative diseases. ▪ The people of Basai will be safe from attacks of mosquitoes and such insects. ▪ Healthy Environment
2.A Recreational value ▪ Influx of tourism at the expense of the environment	2.B Recreational value ▪ Encourage eco-friendly tourism activities
3. Environment value ▪ No migratory birds ▪ Ground water problem ▪ Flash Floods	3.Environment Value ▪ Breeding Place for Migratory birds ▪ Enough ground water availability ▪ It will absorb excess rain and fill the aquifers

"

The questionnaire also provided a brief clarification of what is known about the likely effects of the hypothetical change on wetland management and what would likely happen if nothing was done. This scenario was created to develop an awareness of the valuable effects of the conservation of the Basai wetland and the period in which these benefits would occur. Respondents were then asked if they would be willing to pay for the maintenance and protection of the Basai wetland.

The questionnaire setup comprised of (i) A personal profile (ii) an Interviewee's behaviour regarding numerous features of wetland diversity management (iii) Perception of interviewees for wetland ecosystem (iv) Last part describes the Valuation of Basai wetland. Background information of Basai wetland like the definition of a wetland, nature of Basai wetland, function of the Basai wetland and the role of Basai wetland for the maintenance of environment were provided to the people adjacent to Basai wetland. The full questionnaire information is described in the language understood by the locals (Hindi & Haryanvi).

The contingent market scenario was set up by asking some related questions among the respondents before asking the major questions related to willingness to pay. For this, the detailed areas along the wetland were considered and their properties and situations under urban pressure for urban, industrial and other recultivation uses were explained, as well as the negative and positive aspects of this development. Likewise, the questionnaire was filled with a detailed description of what is thought about the reasonable impacts of the speculative arrangement change and critically, what was probably going to occur in case nothing was done. In addition to other things, this portrayal could explain the significant impacts expected to result from the protection of the wetlands and where and when those advantages would happen.

The different wetland functions and their benefits were flood control, production of the fishery, improved the quality of water etc. Furthermore, this thesis tried to explain the use values and non-use value of the Basai wetland.

Examples of benefits comprised of improved waste disposal functions of wetland, flood control, improved water quality, fishery production function etc.

Besides, this research attempted to give the sample households the most ideal data concerning where the adverse consequences of landfill or recovery would be felt by giving a few very much defined pictures. The material introduced to respondents, additionally incorporated a depiction of how the proposed strategy mediation would function. Attitudinal and perception questions were approached to develop an image of individual's ecological mind set. For this purpose, they were asked "The environmental services that the Basai wetland perform for us are invaluable and cannot be replaced

if destroyed". They were approached to rate these assertions on a mathematical rating scale. At last, family data on pay, age, schooling, sexual orientation, occupation and enrolment of the environmental organisation were additionally gathered.

Image 2.3: Explaining the Basai condition to the respondents during field survey

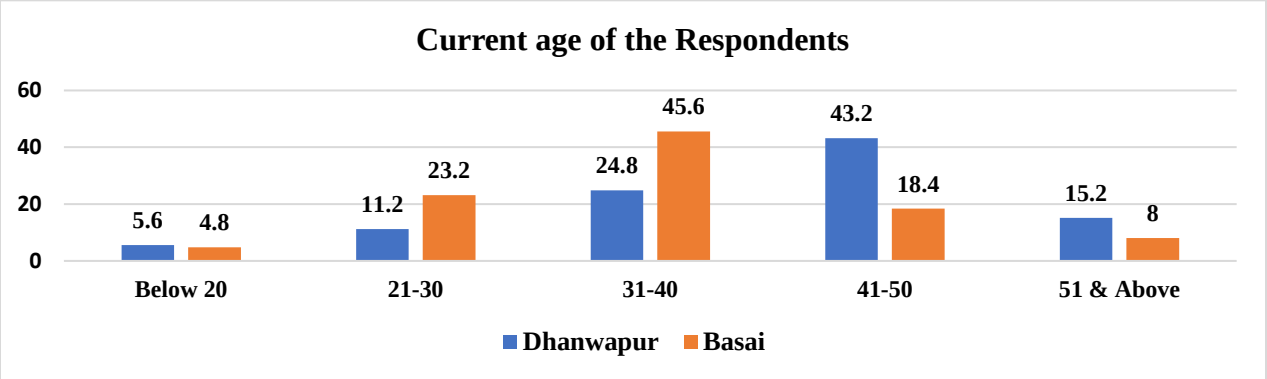
Source: Captured during field survey. (21st dec 2020)

Table 2.1 Dhanwapur and Basai: Demographic & Social Characteristics.

	Dhanwapur		Basai	
	Frequency	**Per centage**	**Frequency**	**Per centage**
Age of the respondents				
20 & below Years	7	(5.60)	6	(4.8)
21-30 Years	14	(11.20)	29	(23.2)
31-40 Years	31	(24.8)	57	(45.60)
41-50 Years	54	(43.2)	23	(18.4)
51 Years & above	19	(15.2)	10	(8)
Total	**125**	**(100)**	**125**	**(100)**
Education				
Illiterate	26	(20.8)	31	(24.80)
Primary	12	(9.6)	16	(12.8)
Middle	18	(14.4)	19	(15.2)
Matriculation	33	(26.4)	28	(22.4)
Senior Secondary	19	(15.2)	18	(14.4)
Graduate	13	(10.4)	12	(9.6)
Post Graduate	4	(3.2)	1	(0.8)
Total	**125**	**(100)**	**125**	**(100)**
Caste of the Respondents				
General	101	(80.8)	74	(59.2)
Backward Caste	24	(19.2)	51	(40.8)
Total	**125**	**(100)**	**125**	**(100)**
Family Type				
Joint	113	(90.40)	82	(65.6)
Nuclear	12	(9.6)	43	(34.4)
Total	125	(1000	125	(100)
Ownership of the house				
Wife	4	(3.2)	3	(2.4)
Self	34	(27.2)	28	(22.4)
Grandfather	11	(8.8)	8	(6.4)
Father	43	(34.4)	39	(31.2)
Father-in-law	9	(7.2)	5	(4)
Landlord	24	(19.2)	42	(33.6)
Total	**125**	**(100)**	**125**	**(100)**

Source: Field survey conducted from December 2020 to January 2021.

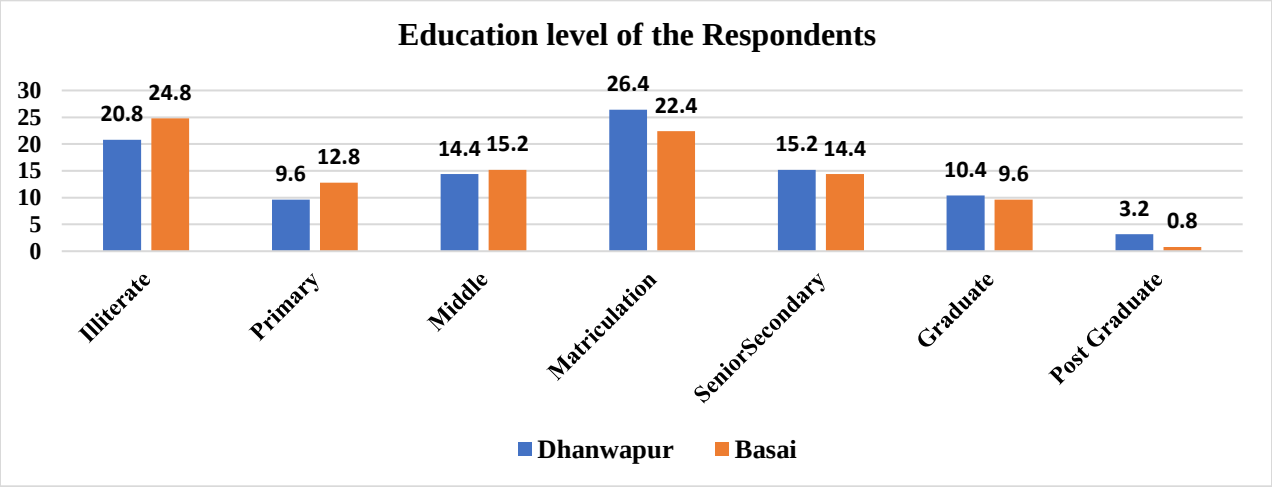
Figure 2.1 Dhanwapur and Basai: Age of the respondents



Source: Data collected during field survey from December 2020 to January 2021.

Figure 2.1 depicts the comparison of the age group of the respondents between Basai and Dhanwapur village adjacent to Basai wetland. The age group varies from below 20 years to above 51 years as everyone having the full right to participate in the survey and primarily to remove all the age-related biasness. Major differences could be seen in the age group from below 20, 21-30, 31-40, 41-50 and above 51 in the population sample. For both the villages, the age group below 20 was having a slight difference of 0.8 percent points with a higher per centage of Dhanwapur (5.6 per cent). Basai village was (23.2 per cent) 12 percent points higher than Dhanwapur (11.2 per cent) in the age group of 21-30 years. Moreover, for the age group 31-40 Basai village population sample was (45.6 per cent) one-fifth percentage higher than Dhanwapur village but for the age group, 41-50 Dhanwapur village (43.2 per cent) was one-fourth percentage higher than the Basai village population sample. The population sample above 51 years was having a 7 percent points difference with Dhanwapur village (15.2 per cent) higher percentage in the population sample.

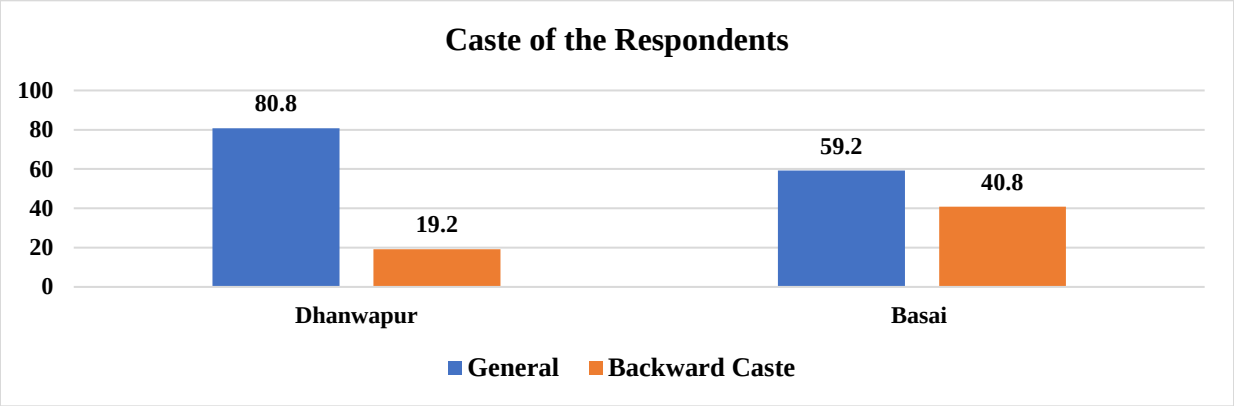
Figure 2.2 Dhanwapur and Basai: Education level of the respondents



Source: Data collected during field survey from December 2020 to January 2021.

Fig 2.2 presents a comparison of educational levels between the two villages in the vicinity of the Basai wetland. Prominent differences could be seen in the levels of illiteracy and educational attainment at primary, matriculation and postgraduate level. The survey data were taken from illiterate to postgraduate level to remove education biasness. In Basai village, the illiterate population constituted nearly one-fourth (24.8 per cent) of the sample population while about one-fifth (20.8 per cent) of the sample population in Dhanwapur village was illiterate. The Basai village had a relatively higher percentage of primary and middle education levels among its sample population which was 3.2 and 0.8 percent points higher than that of Dhanwapur village. However, concerning higher secondary, senior secondary, graduate and postgraduate levels, Dhanwapur village had an edge over Basai village (Fig 2.2). The most prominent difference was seen at the higher secondary education level (matriculation) where Dhanwapur village (26.4 per cent) had 4 percent points more population in the category as compared to that of Basai village (22.4 per cent). Another stark difference existed at the postgraduate level where Dhanwapur village (3.2 per cent) had 2.4 percent points more population belonging to the category against only 0.8 per cent of the sample population of Basai village (Fig 2.2). Similarly, at senior secondary and graduate level, the percentage of the population of Dhanwapur village was higher (0.8 per cent point each) as compared to that of Basai village. Hence, it can be said that the level of educational attainment was higher in Dhanwapur village.

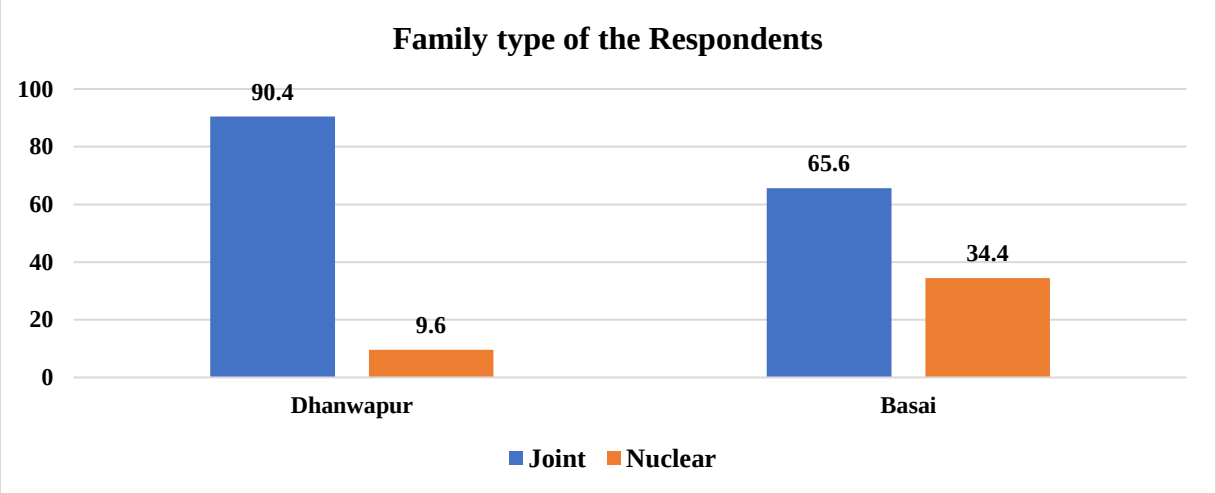
Figure 2.3 Dhanwapur and Basai: Caste of the respondents



Source: Data collected during field survey from December 2020 to January 2021.

Figure 2.3 presents the caste comparison between the two villages in the vicinity of Basai wetland i.e., Basai village and Dhanwapur village. The graph shows that Dhanwapur village was having a more general caste population (80.8 per cent) with a 61 percent points difference as compared with Basai village (19.2 per cent). The maximum population residing in Dhanwapur village were Jaats. In Basai village the percentage points difference was 18.4 for caste and general caste people were more in Basai village (59.2 per cent) as compared with backward caste (40.8 per cent). The reason behind more backward caste people residing in Basai village was cheap house rent and daily wager opportunity.

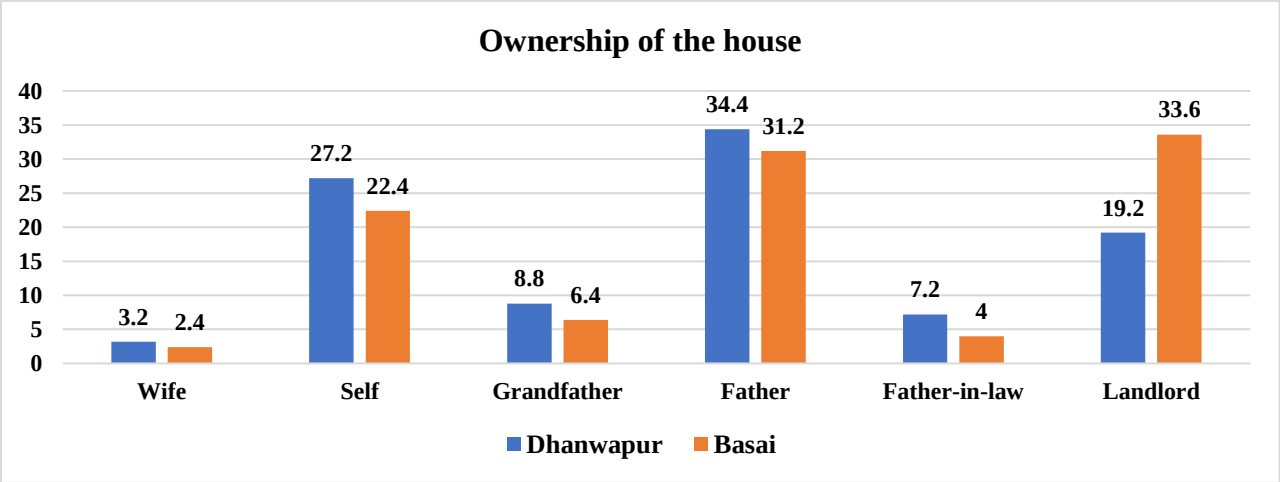
Figure 2.4 Dhanwapur and Basai: Family type of the respondents



Source: Data collected during field survey from December 2020 to January 2021.

Figure 2.4 presents the comparison of family type data between Basai village and Dhanwapur village. The graph presents a prominent difference in the joint family and nuclear family for both the villages. Dhanwapur village had a huge 80 percent points difference between joint family and nuclear family with more joint family (90.4 per cent) residing. In Basai village the percent points difference for the family type was 31.2, and similar with Dhanwapur village more joint families (65.6 per cent) were residing in Basai village.

Figure 2.5 Dhanwapur and Basai: Ownership of the house



Source: Data collected during field survey from December 2020 to January 2021.

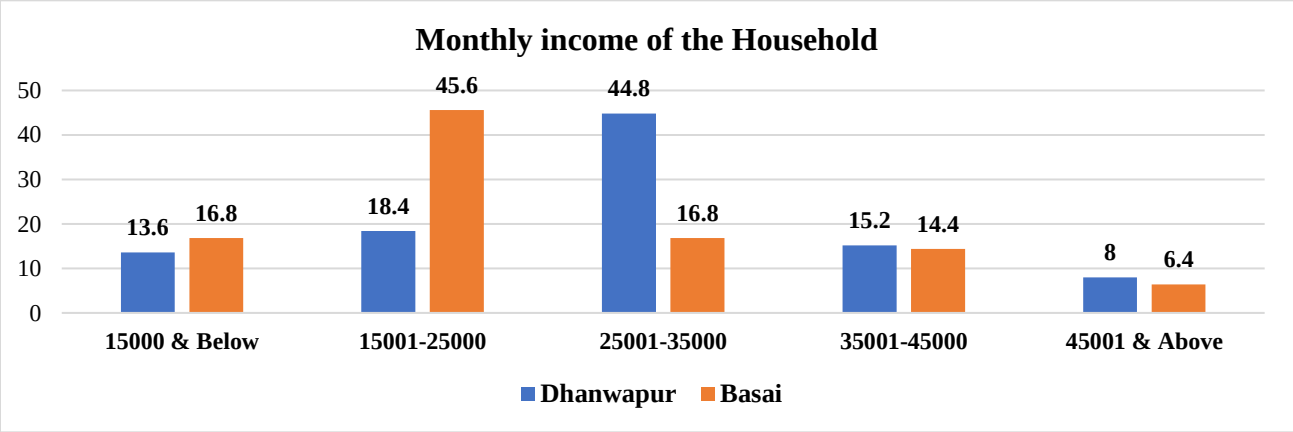
Figure 2.5 presents a comparison of ownership of the household between Basai village and Dhanwapur village from the population sample. The prominent changes could be seen for Self, father and landlord from the two villages population samples. There was a very slight percent points difference of 0.8 for both the villages in which the wife was the owner of the house. Dhanwapur village was 4.8 percent points higher (27.2 per cent) from Basai village in which the owner was the respondent. The households in which grandfather was the owner presents 2.4 percent points difference for Dhanwapur village was higher (8.8 per cent) than Basai village. Dhanwapur village was 3.2 percent points higher (34.4 per cent) (7.2 per cent) in which the ownership of the house was either the respondent's father or father-in-law. Basai village population sample depicts the huge 14.4 percent points difference (33.6 per cent) in which the owner was the landlord.

Table 2.2 Dhanwapur and Basai: Economic Characteristics.

	Dhanwapur		Basai	
Monthly income of the household				
	Frequency	**Per centage**	**Frequency**	**Per centage**
Rs 15000 & below	17	(13.6)	21	(16.80)
Rs 15001- Rs 25000	23	(18.40	57	(45.6)
Rs 25001- Rs 35000	56	(44.8)	21	(16.8)
Rs 35001- Rs 45000	19	(15.20)	18	(14.4)
Rs 45001 & above	10	(8.0)	8	(6.4)
Total	**125**	**(100)**	**125**	**(100)**
Occupation				
Unemployed	19	(15.2)	23	(18.4)
Farmer	47	(37.6)	17	(13.6)
Business	9	(7.2)	12	(9.6)
Daily Wager/Labourer	11	(8.8)	21	(16.8)
Private Service	26	(20.8)	39	(31.2)
Government Service	10	(8)	12	(9.6)
Retired/Pensioner	3	(2.4)	1	(0.8)
Total	**125**	**(100)**	**125**	**(100)**
House ownership				
Own	101	(80.8)	83	(66.4)
Rented	24	(19.2)	42	(33.6)
Total	**125**	**(100)**	**125**	**(100)**
Type of house				
Semi-Pucca	19	(15.2)	15	(12)
Pucca	106	(84.8)	110	(88)
Total	**125**	**(100)**	**125**	**(100)**

Source: Field survey conducted from December 2020 to January 2021.

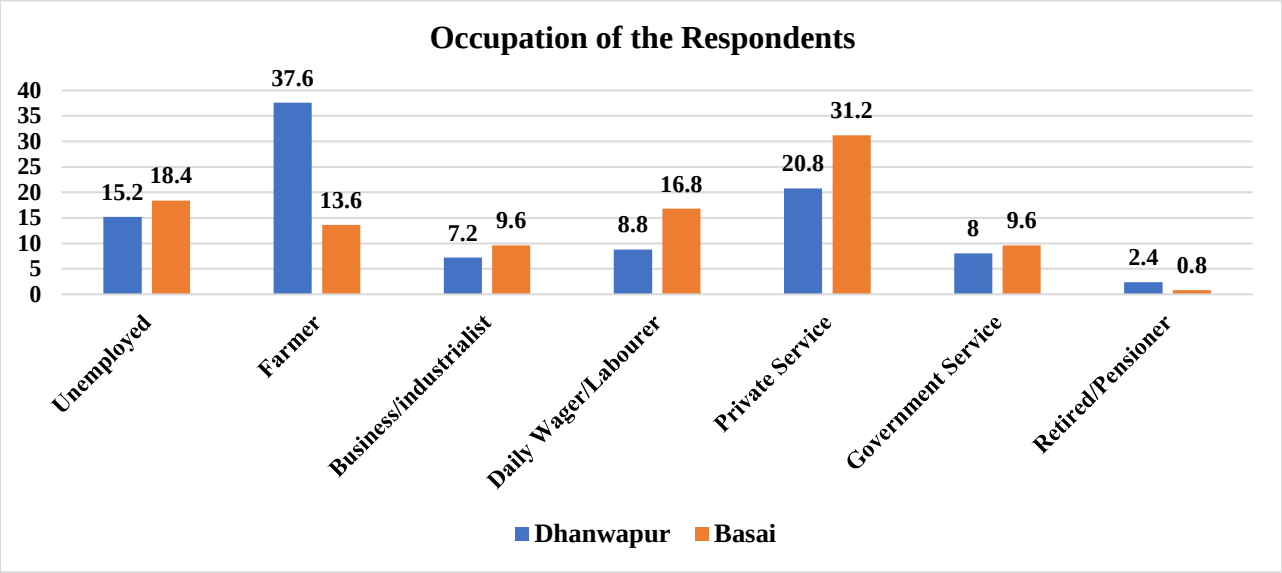
Figure 2.6 Dhanwapur and Basai: Monthly income of the household



Source: Data collected during field survey from December 2020 to January 2021.

Figure 2.6 presents the comparison of a monthly income of the household between Basai village and Dhanwapur village population sample. Prominent differences could be seen in the monthly income of the household at 15001-25000 and 25001-35000 range. For the monthly income range below 15000, 35001-45000 and above 45001 the percent points difference was 3.2, 0.8 percent and 1.6 percent respectively with Dhanwapur higher at below 15000 only and Basai village was higher for (15.2 per cent) 35001-45000 and (8 per cent) above 45001. The monthly income range 15001-25000 shows more than one-fourth difference in which Basai village population sample shows a (45.6 per centage) higher one. The maximum percent points difference was 28 per centage points for the monthly income range 25001-35000 with Dhanwapur village population sample was higher (44.8 per centage) as compared to Basai village. So, we can say that the Dhanwapur village population sample was having a good higher monthly income range as compared to Basai village.

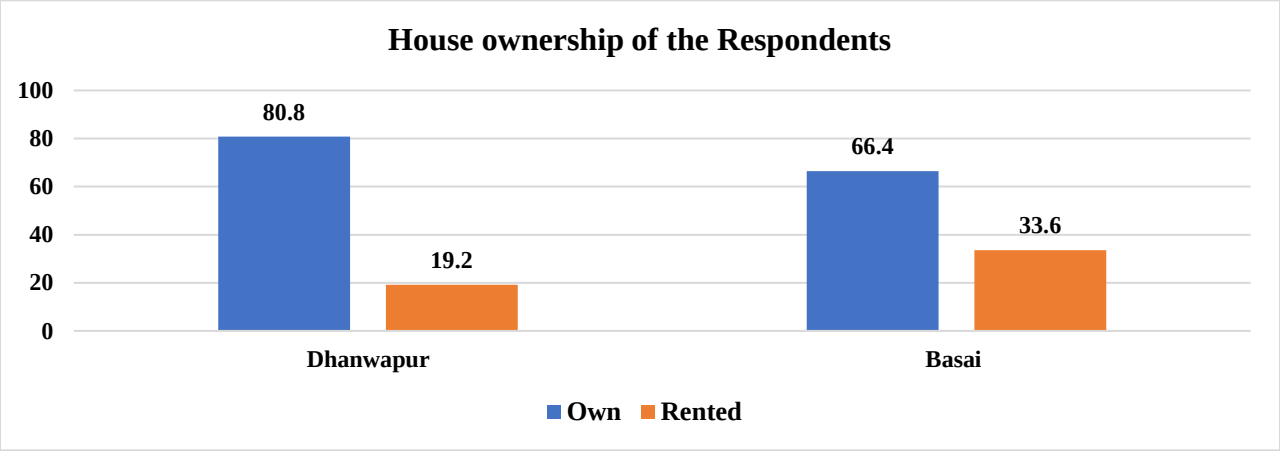
Figure 2.7 Dhanwapur and Basai: Occupation of the respondents



Source: Data collected during field survey from December 2020 to January 2021.

Figure 2.7 presents a comparison of different occupations between Basai village and Dhanwapur village. The prominent difference could be seen for farmers, daily wager/labourer and private service. The economic condition of a household was mainly dependent upon the category of employment level, whether it is a job or a business. The unemployment level was higher in (18.4 per cent) Basai village with a 3.2 percent points difference as compared with the Dhanwapur village population sample. The Dhanwapur village had a relatively higher percentage of farmers which was one-fourth higher (37.6 per cent) than the Basai village, the main occupation in Dhanwapur village was dairy farming, self-farming and giving land on lease for farming. Business/industrialists had more in Basai village with 2.4 percent points higher (9.6 per cent) than Dhanwapur village but the businesses in Basai village were of small levels like shops, real estate or Dhaba owners. Similarly, daily wager/labourer was 8 percent points higher in Basai village (16.8 per cent) than Dhanwapur village. Again, for private service, the Basai village population sample was 10 percent points higher (31.2 per cent) than Dhanwapur village. At last, there was a 1.6 percent points difference for government service and retired pensioner in both the villages.

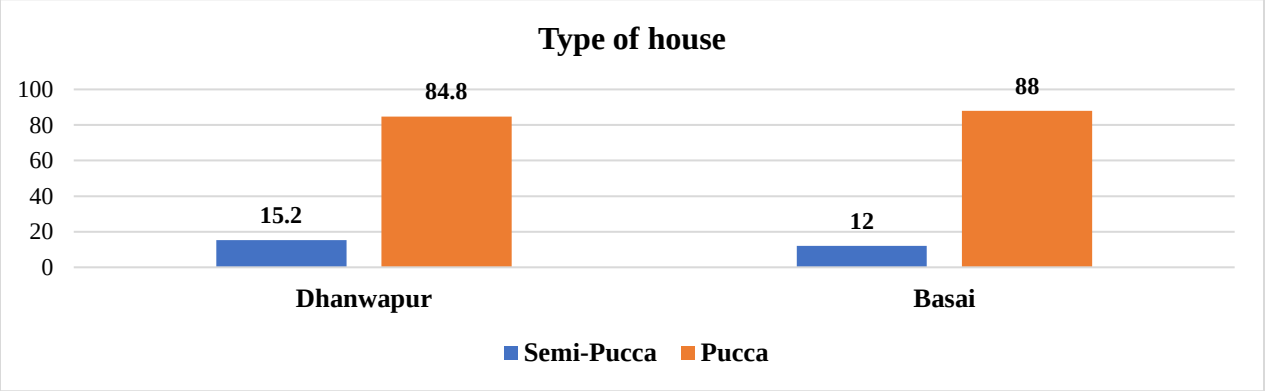
Figure 2.8 Dhanwapur and Basai: House ownership (rented or owned)



Source: Data collected during field survey from December 2020 to January 2021.

Figure 2.8 presents the comparison of house ownership between Basai village and the Dhanwapur village population sample. In Dhanwapur village, the house ownership showed a difference of 61.6 percent points in which more houses were owned registered (80.8 per cent) as compared to rented (19.2 per cent) ones. Basai village presents a 32.8 percent points difference with higher Owned houses (66.4 per cent) and lesser rented (33.6 per cent) houses.

Figure 2.9 Dhanwapur and Basai: Type of the house



Source: Data collected during field survey from December 2020 to January 2021.

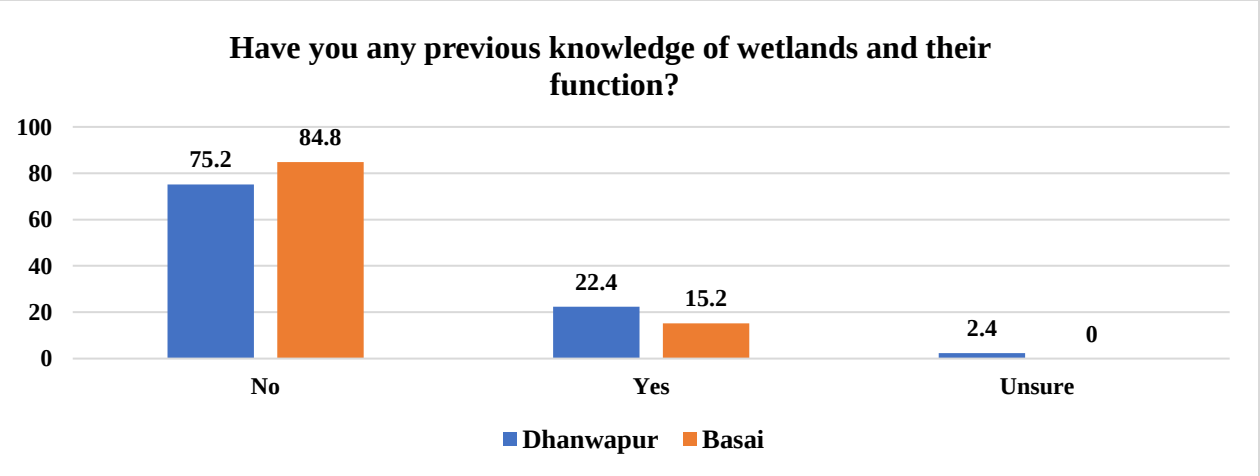
Figure 2.9 presents the comparison of the type of houses for Basai and Dhanwapur villages. There was no Kutcha house in both the villages due to the implementation of Pradhan Mantri Awaas Yojana (MoHUA, 2015) which was discussed with the respondents. In Dhanwapur village pucca houses were 70 percent points higher (84.8 per cent) than semi-pucca houses. Basai village showed 76 percent points higher (88 per cent) for pucca houses as compared with semi-pucca houses.

Table 2.3 Dhanwapur and Basai: Knowledge about wetland environment.

Are you a member of an environmental organization?				
	Dhanwapur		**Basai**	
	Frequency	**Per cent**	**Frequency**	**Per cent**
Yes	0	0	0	0
No	125	100	125	100
Have you any previous knowledge of wetland and their functions?				
No	94	75.2	106	84.8
Yes	28	22.4	19	15.2
Unsure	3	2.4	0	0
What according to you is the best agency to conserve biodiversity in the Basai wetland?				
State Government	63	50.4	57	45.6
HSVP	11	8.8	15	12
Village Panchayat	25	20	34	27.2
A coalition of State agencies and NGO's	26	20.8	19	15.2
Total	**125**	**100**	**125**	**100**

Source: Field survey conducted from December 2020 to January 2021.

Figure 2.10 Dhanwapur and Basai: Knowledge regarding wetland functions

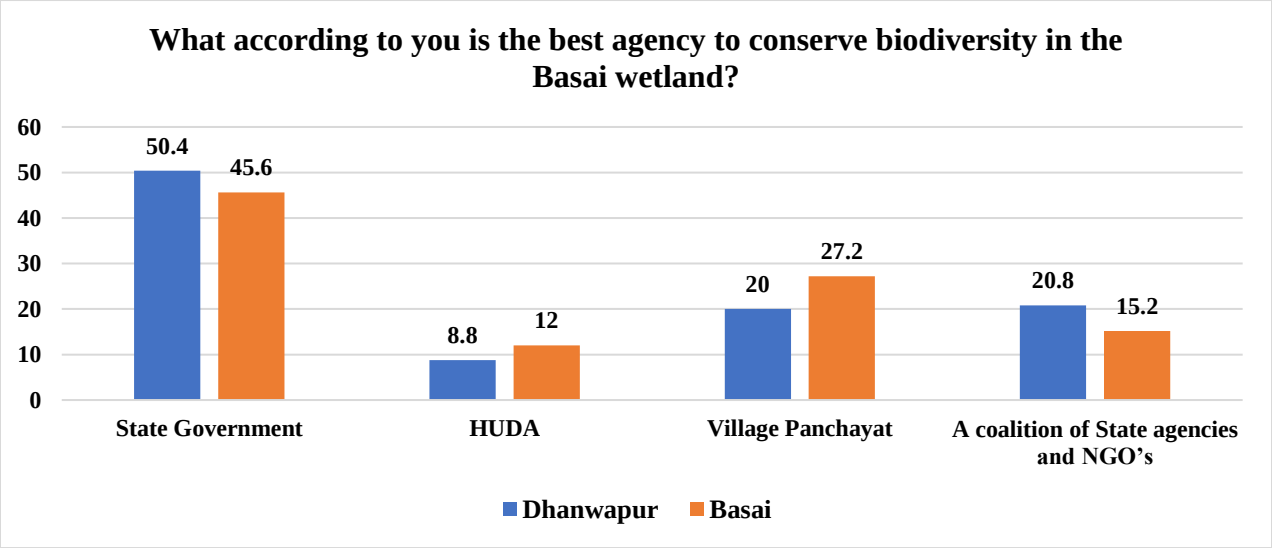


Source: Data collected during field survey from December 2020 to January 2021.

Figure 2.10 presents the comparison of wetland knowledge and their function between Basai and Dhanwapur villages. Basai village respondents were not aware of the wetlands and their functions with a 9.6 percent points difference from Dhanwapur village respondents. The respondents who know wetlands and their functions present a 7.2 percent points difference with Dhanwapur villagers were

more (22.4 per cent) aware than Basai villagers. This shows that Dhanwapur village respondents were more aware of the functions and importance of wetlands.

Figure 2.11 Dhanwapur and Basai: Best agency to conserve Basai wetland



Source: Data collected during field survey from December 2020 to January 2021.

Figure 2.11 presents the comparison of the best agency to conserve the Basai wetland between Basai village and Dhanwapur village. The prominent changes could be seen in all the categories. In Dhanwapur village respondents were more (50.4 per cent) to choose state government with a 4.8 percent points difference in comparison with Basai village respondents. 3.2 percent points difference were shown for HSVP (Haryana Shahari Vikas Pradhikaran) with Basai village respondents were higher (12 per cent) compared with Dhanwapur village respondents. Similarly, Basai village respondents were more (27.2 per cent) likely to choose village panchayat with a 7.2 percent points difference as compared with Dhanwapur village. Dhanwapur village respondents were 5.6 percent points difference higher (20.8 per cent) than Basai village respondents when the conservation agency was a coalition of state agencies and NGO's.

2.4 RESPONDENT PERCEPTIONS ABOUT ECOSYSTEM SERVICES

The wetlands its functions and services are very much important for the existence of humans. Still, its value is not yet determined to a large extent and now its protection on a global level becomes a major issue. Still, the actual protection and conservation of the wetlands are not effective as anticipated. So, the protection of wetlands involves people's attitude and their perceptions at different

levels. The main point is the awareness about the wetlands and their functions. More aware people about the wetlands and their functions are more likely they are having an attitude for the protection of the wetlands.

Table 2.4: Reliability Test

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.724	0.736	10

Source: Field data analysed in IBM SPSS Statistics 20.

Cronbach's Alpha is a reliability test to measure the internal consistency of different groups as a set of items. The Cronbach alpha is a reliability test to check the multiple questions for a five-point Likert scale. For the contingent valuation method, respondents were asked to give their perceptions about environmental goods and services for the first five statements. The second part of the five statements were regarding Basai wetland willingness to pay for their conservation and management. The result for Cronbach's Alpha was 0.724 which comes under the range of 0.71-0.80, and this implies that the result is good and acceptable.

Table 2.5: Respondent perception for Basai wetland services.

S. No		N	Mean	Std. Deviation	Range	
1	The environmental services that the Basai wetland perform for us are invaluable and cannot be replaced if destroyed.	250	4.59	0.685	4.21-5.00	Strongly Agree
2	The Government should not pursue developmental programs that damage the biodiversity of the Basai Wetland.	250	4.21	0.864	3.41-4.20	Agree
3	It is the duty of the people to protect the environment. Hence. They should take the initiative.	250	3.94	0.914	2.61-3.40	Neutral
4	The Basai wetland supports 240 species of birds. It does not matter if a few of the species are lost.	250	1.8	0.696	1.81-2.60	Disagree
5	It does not matter if the wetland Is reclaimed for development activities.	250	1.48	0.736	1.00-1.80	Strongly Disagree

Source: Field survey conducted from December 2020 to January 2021.

Table 2.5 depicts the Basai and Dhanwapur villages people perceptions about the Basai wetland. For this five-point Likert scale was used to know individuals' attitudes and perceptions of how much they agree or disagree about the particular statement. The first statement said that the services which Basai wetland perform is very useful and cannot be replaced if the wetland is disintegrating. The mean value for the first statement is 4.59 and comes under the range 4.21-5.00, this implies that respondents strongly agree that the Basai wetland is very useful and cannot be replaced. The second statement said that the development projects which was started by the Government should be stopped that will affect the Basai wetland biodiversity. The mean value for the second statement is 4.21 and comes under the range 3.41-4.20, this implies that respondents agree that development projects along the Basai wetland should be stopped. The third statement said that the protection of the environment is the duty of the people and they should take initiative. The mean value for the second statement is 3.94 and comes under the range 2.61-3.40, this implies that respondents are neutral and they are not much action to take initiative for environment protection. The fourth statement said that the Basai wetland is the home of nearly 240 bird's species (ENVIS, 2016) and if these species are lost then it will not be a matter of concern for anyone. The mean value for the fourth statement is 1.8 and comes under the range 1.81-2.60, this implies that the respondents have disagreed about the statement and the decreasing number of birds species is a matter of concern for the respondents. The fifth statement said that there is no matter of concern if the wetland is encroached by the development activities. The mean value for the last statement is 1.48 and comes under the range 1.00-1.80, this implies that respondents are strongly disagreed about the statement and are extremely concerned if the Basai wetland will encroach by the development activities.

Table 2.6 Respondent's perception and willingness for the conservation of Basai wetland.

S. No		N	Mean	Std. Deviation	Range	
1	Environmental quality degradation in Haryana will become more widespread in years to come.	250	4.43	0.744	4.21-5.00	Strongly Agree
2	Are you satisfied with the environment quality of Basai Wetland?	250	1.42	0.72	1.00-1.80	Strongly Disagree
3	Deterioration in the quality and services provided by the Basai Wetland ecosystem will affect indirect users of this resource.	250	4	0.741	3.41-4.20	Agree
4	In the absence of any concrete initiatives to conserve biodiversity the people will take up the initiative.	250	3.93	0.834	3.41-4.20	Agree
5	I may donate money to conserve biodiversity of the Basai Wetland ecosystem.	250	4.13	1.184	3.41-4.20	Agree

Source: Field survey conducted from December 2020 to January 2021.

Table 2.6 depicts the respondent's perception and their willingness to pay for the conservation of the Basai wetland. The first statement described the declining quality of the environment in Haryana in the coming future and the mean value for this statement is 4.43 which comes under the range of 4.21-5.00 this implies that respondents strongly agree about the statement. The second statement is about the satisfaction level of respondents towards the quality of Basai wetland and the mean for this statement is 1.42 which comes under the range of 1.00-1.80 which shows that respondents have strongly disagreed because they thought that the quality of Basai wetland is worst. The third statement said that the declining quality of Basai wetland services would affect the indirect users. The mean for the third statement is 4 which implies that respondents agree about the statement that the poor quality of Basai wetlands services affects the indirect users like groundwater recharge, soil quality, avifauna etc. The fourth statement focuses on local people participation in the protection of the Basai wetland. The mean for this statement is 3.93 which comes under the range 3.41-4.20, this implies that respondents agree about their participation of local people is needed for the protection and

conservation of Basai wetland. The fifth statement was about the willingness to pay for the conservation of the Basai wetland and the mean value for this statement is 4.13 which shows that respondents agree for willingness to pay for the Basai wetland.

Table 2.7 Respondent's willingness to pay for Basai wetland.

If by 2022, the Wetlands (Conservation and Management) Rules, 2017, Basai wetland is to achieve the desired environmental quality explained in situation B, we will have to start taking many additional environmental measures now both in and around the Basai Wetland and at the State and National level. The additional environmental measures that we will have to take in the city to achieve this environment are going to cost money. Would you be willing to share this cost?				
	Dhanwapur		Basai	
	Frequency	Percent	Frequency	Percent
Yes	116	(92.8)	114	(91.2)
No	9	(7.2)	11	(8.8)
Assume that a body, reputed for doing efficient and honest work undertakes the task of protecting the Basai Wetland from further degrading activities like Pollution, large scale Basai Wetland land reclamation, waste dumping and such other external activities so that we can at least maintain the current Scenario from further degradation will you be willing to support such a move?				
Yes	120	(92.8)	114	(91.2)
No	5	(7.2)	11	(8.8)
If you are not willing to contribute, which of the following reasons best describes why you would not be willing to pay anything?				
I don't believe my payment will help in stopping the degradation of the Basai Wetland	94	(75.2)	106	(84.8)
It is not worth anything to me	9	(7.2)	11	(8.8)
It is the Government's duty to pay for such expenses	22	(17.6)	8	(6.4)
Suppose that the additional environmental measures would mean that your household would have to contribute a onetime payment of ___10,20,50,100… Rupee to achieve the environment which can be expected as a result of a more stringent environment policy by the year 2022, given your budget constrain would you be willing to contribute the amount?				
Yes	116	(92.8)	114	(91.2)
No	9	(7.2)	11	(8.8)
Total	125	(100)	125	(100)

Source: Field survey conducted from December 2020 to January 2021.

Table 2.7 depicts the household willingness to pay for the conservation and management of the Basai wetland. More the 90 per cent of the household from both the villages were willing to share the cost with the government under the Wetlands (Conservation and Management) Rules, 2017 for maintaining the desired environmental condition around Basai wetland which was discussed in the Situation B. More the 95 per cent of households from Dhanwapur and more the 90 per cent household from Basai village were supporting the move to stop further degradation of Basai wetland. Nearly 3/4 of respondents from Dhanwapur village and 85 per cent from Basai village thought that their monetary contribution would not help in stopping the further degradation of Basai wetland. The main reason, which played an important role in determining the maximum amount contribution by the household from both the villages were for constructing recreational activity like the park or a walking pathway near Basai wetland.

2.5 TOTAL WILLINGNESS TO PAY ESTIMATION

The contingent valuation method is used to know about the willingness to pay for the conservation and management of the wetland services. For knowing willingness to pay from the respondents the questionnaire was designed in such a manner that initially the wetland goods and services was explained in detail after that the main willingness to pay question was asked. Two different hypothetical situations were explained face to face to the respondents in which the first situation happened if the Basai wetland was conserved and maintained and the second situation happened if the Basai wetland was ignored and encroached.

The willingness to pay amount for Basai wetland vary from Rs 0 to Rs 2100. Table 2.7 depicts willingness to pay by the respondents shows that 1/5th of the total was able to pay the sum of Rs 500 and 1/6th of the total was able to pay the sum of Rs 1000 per month for the conservation and management of Basai wetland.

From the total of 250 respondents, the mean amount was estimated of Rs 832 and this amount will further help for the calculation of the Total Economic Value of the Basai wetland. The reason for such a huge mean willingness to pay amount is that Basai is an urban wetland and the residents adjacent to Basai wetland are educated and much aware about the wetland services and goods. Dhanwapur village accounts for more amount as there are more literate people with a good economic status. Most of them were landlords and their business was dairy farming. In Basai village most of

the respondents were in private sectors and daily wagers and their response for the willingness to pay was low.

Table 2.8 The maximum amount of money that a household would be willing to contribute to the conservation and management of Basai Wetlands.

Amount	Frequency	Per centage
Rs 0	20	(8)
Rs 10	12	(4.8)
Rs 50	17	(6.8)
Rs 100	34	(13.6)
Rs 500	51	(20.4)
Rs 800	9	(3.6)
Rs 1000	41	(16.4)
Rs 1100	32	(12.8)
Rs 1500	12	(4.8)
Rs 2000	18	(7.2)
Rs 2100	4	(1.6)
Total	**250**	**(100)**

Source: Field survey conducted from December 2020 to January 2021.

Table 2.8 depicts that how much maximum amount would be contributed by the household for the conservation and management of the Basai wetland. Out of a total of 250 households, only 8 per cent were denied any monetary contribution but the rest of the households were willing to pay the money. The maximum households i.e., 20 per cent were willing to pay rupee 500/- and 16 per cent were ready to pay 1000/- rupee. Surprisingly 4 households were willing to pay 2100/- rupee per month.

2.6 SUMMARY AND CONCLUSION

Wetlands are an important part of the ecosystem and a dominant natural resource that can be conserved and maintained for the existence of humans. The fight against climate change can be won by preserving the wetlands because wetlands are the natural source that can soak atmospheric carbon more rapidly than forests. The marine and coastal wetlands can store twice carbon contents as compared to the tropical forests. (Madgwick, 2021). There is much international organisation (Ramsar, What are wetlands?, 1971) and government rules (Ministry Of Environment, 2017) that are functional for the protection and conservation of wetlands. Still, the condition of the wetlands is deteriorating, so many valuation techniques were innovated by many environmentalists to give

monetary benefit for the wetland goods and services. These valuation techniques were works according to the direct or indirect benefit of the wetland goods and services. The contingent valuation method was one of the valuation techniques for valuing the wetlands.

The contingent valuation method is a direct valuation of ecosystem services. The Contingent valuation method is based on people's willingness to pay for the ecosystem services and it will show the economic value of the ecosystem. For this research, the ecosystem service is the Basai wetland. For knowing the Contingent valuation method structured questionnaire was framed and 250 face-to-face Schedule method was done in two villages adjacent to the Basai wetland.

The major objective of this chapter was to analyse the direct benefit of the Basai wetland. This chapter explains the details of the contingent valuation method that was done by the primary survey. The survey questionnaire was formed to know the people perception and their willingness to pay for the wetland services and future conservation.

From Dhanwapur and Basai village. The demographic information of Dhanwapur village showed that they were more literate as compared to Basai village and they were also economically sound. The result shows that the average amount for willingness to pay was Rs 832 which was a good amount as compared to another literature review (Abraham, 2004). The reason for this was that Basai wetland is an urban wetland and the people living adjacent to the wetland were having good per capita income and they are more concerned about the conservation and protection of the wetland as discussed during the field survey.

The contingent valuation was further used in the next chapter for knowing the total economic valuation of the Basai wetland.

CHAPTER 3

ESTIMATING THE TOTAL ECONOMIC VALUE OF BASAI WETLAND

3.1 INTRODUCTION

Wetlands are among the most different and useful environmental ecosystems of the world and are of enormous socio-economic significance. Wetlands give a wide variety of goods and products to the surrounding people and individuals living on the peripheries. Wetlands give a large number of goods and products to society, supporting a huge number of individuals throughout the globe. Undoubtedly, the goods and products of wetlands help human life, protect environmental degradation which further helps in climate change (DEE, 2019).

Ramachandra et al. in their research stated that the anthropogenetic activities affect biological, physical, and chemical processes of wetlands, which damage the wetlands ecosystem functioning and causing decay and deterioration of wetland ecosystem services and also decreasing economic value of wetlands. The global values of direct goods from wetland and associated ecosystems services have been estimated at US$16 trillion annually (Costanza & et al., 1997). They provide food, feed, fuel and water for domestic, irrigation and industrial use. They are essential to help reduce poverty. In addition, due to its functions in the hydrological and chemical cycles, it also serves as a kidney of the landscape. Despite their important role in maintaining healthy ecosystems and contributing to the livelihood of the local population, wetlands are threatened by the deterioration of river basins and the diversion of water that is causing changes in the water balance. Many parts of the world have lost or destroyed wetlands, mainly due to agricultural use, urbanization, overexploitation by local people, and poorly planned development activities. As a result, wetlands are overused and undervalued. Several studies have been carried out on the economic valuation of wetlands around the world; however, very few studies focus on the macroeconomic contribution of wetlands. The annual value of wetland goods and services was estimated to be the second-highest, US $ 14,778 / ha, based on the assessment of 17 ecosystem services in 16 biomes with a focus on social welfare. (Ramachandra & et, al, 2011).

Various research recommended that there is not a reasonable meaning of wetlands Goods and products and the genuine monetary worth of wetland services also, their significance to social wellbeing assistance and nearby and public economy, is the key reason for poor management of such

assets. Hence the main objective of this chapter is to find the Total Economic Value of the Basai wetland by knowing the Use value and Non-Use Value.

Table 3.1 The total economic value of wetlands

USE VALUE	Direct Value	Raw material and physical products that are used for production, consumption and sale.	e.g., wood, minerals, fish, fuels, foods building materials, medicines, fodder, recreation etc.
	Indirect Value	Ecological functions which conserve and maintain human and natural systems.	e.g., watershed protection, nutrient cycling, pollination, flood attenuation, climate regulation, protection against storms & natural disasters etc.
	Option Value	The premium placed on maintaining ecosystems for future possible uses, some of which may not be known now.	e.g., new industrial agricultural or pharmaceutical applications, future tourism, and recreational development, novel possibilities of resource use etc.
NON-USE VALUE	Existence Value	The intrinsic value of ecosystems regardless of current or future possibilities to use them.	e.g., historical and cultural sites, spiritual places, beautiful landscapes, items of national heritage and bequest for future generations etc.

Source: (Emerton & Bos, 2004)

The total economic value will be calculated by knowing the use-value and non-use value of the wetland. The use-value was calculated in the previous chapter by the Contingent Valuation Method which was based on a primary survey for knowing the people's willingness to pay. The non-use value will be calculated in this chapter by the Hedonic Pricing Method.

3.1.1 HEDONIC PRICING METHOD

Pricing is a strategic decision for all companies. Not only does it generate income for the survival of a company, but it can also be used as a correspondent, negotiation tool and weapon of competition. The buyer can use the price as a means of comparing products to evaluate the value for money or the quality of the product. In tourism, pricing decisions are often complex. For example, the price of a hotel room is often influenced by seasonality, the type of room, the facilities provided, or even the attributes of the external environment such as noise, pollution, distance from a landmark in the particular or outside environment (Papatheodorou & Apostolakis, 2016).

From a management perspective, understanding consumer perception of each of the attributes associated with the price is critical: the characteristics that a customer is willing to pay more for and those that will help determine consumer choices and decisions, preferences are irrelevant (Chen & R, 2010). Hedonic Price Method (HPM) makes it easy to see which characteristics are valued by the buyer and to what extent.

The goods and services produced by the wetlands were not traded in the market and makes it difficult to estimate their valuation. There are many valuations technique available for knowing this untraded non-market good and services produced by the wetland. One of these techniques, the Hedonic pricing method uses the house price for knowing the valuation of wetland services (Mahan, Polasky, & Adams, 2000). The house price is based on many housing characteristics like the number of bedrooms number of bathrooms and the ecosystem services surrounding the house like a park or a lake.

The hedonic pricing model was first given by labour economist Sherwin Rosen from the USA in the year 1974 (Rosen, 1974). This model is related to the property price variation. The property price which an individual pay for commodities reflects environmental and non-environmental characteristics. Hedonic price relates the property price with the environmental attributes (Mahan, Polasky, & Adams, 2000).

3.2 DATA SOURCE AND METHODOLOGY

The first part of the data source for calculating the total economic valuation of the Basai wetland was done in chapter 2 by the contingent valuation method (CVM). The final part of the data source was calculated in this chapter by Hedonic pricing method (HPM) and adding up the contingent valuation method.

The Non-Use Value was calculated by Hedonic Pricing Method (HPM) and then both values will be used for finding the final Total Economic Value of the Basai Wetland.

Total Economic Value (TEV) = Use Value [Direct-use value + Indirect-use value + Option value] + Non-use Value [Existence value + Bequest value + Philanthropy value]

Use Value: -

• Contingent Valuation Method- Willingness to pay for ecosystem services.

Non-Use Value: -

• Hedonic Pricing - Impact on land values, assuming that the wetland functions are fully reflected in land prices.

3.3 SURVEY AND DATA COLLECTION

A questionnaire was built to get information from the respondents about the frequencies of demographic characteristics and household characteristics. The survey was conducted from December 2020 to January 2021 and the questionnaire was filled using the schedule method by 250 respondents from Dhanwapur village and Basai village. As mentioned in the literature review section, the property price is used as a substitution to evaluate the economic value of Basai Wetlands. In this chapter, the house price is used as a measurement for knowing the economic value of Basai Wetland. The location factor influences the house price (Burinskiene, Rudzkiene, & Venckauskaite, 2011). Therefore, two residential areas adjacent to the Basai wetland are chosen for this chapter to avoid any bias in data analysis. The name of the two villages was Basai and Dhanwapur.

3.4 RESULT ANALYSIS

Table 3.2 Dhanwapur & Basai Villages: Demography of household survey.

Age of the respondents		
	Frequency	**Per centage**
20 Years & Below	13	(5.2)
21-30 Years	43	(17.2)
31-40 Years	88	(35.2)
41-50 Years	77	(30.8)
51 Years & above	29	(11.6)
Total	**250**	**(100)**
How long have you been in Basai/ Dhanwapur village?		
5 Years	19	(7.6)
8 Years	20	(8)
10 Years	24	(9.6)
12 Years	16	(6.4)
15 Years	40	(16)
20 Years	124	(49.6)
25 Years	7	(2.8)
Total	**250**	**(100)**
Caste of the respondents		
General	175	(70)

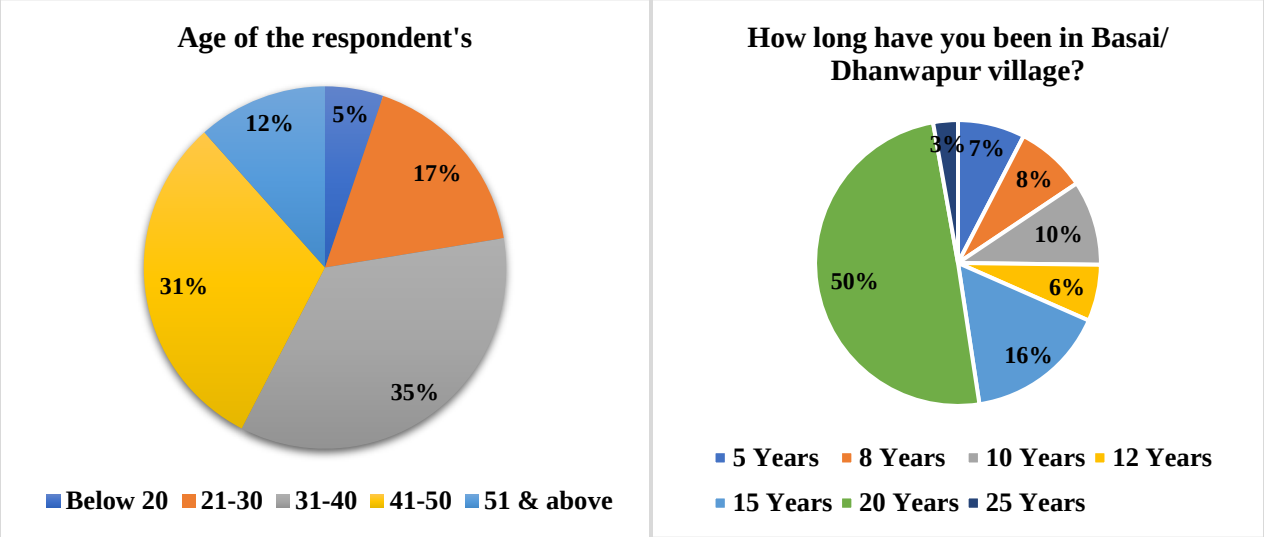
Backward Caste	75	(30)
Total	250	**(100)**
Education level of the respondents		
Illiterate	57	(22.8)
Primary	28	(11.2)
Middle	37	(14.8)
Matriculation	61	(24.4)
Senior Secondary	37	(14.8)
Graduate	25	(10)
Post Graduate	5	(2)
Total	250	**(100)**
Education level of the respondent's spouse		
Illiterate	82	(32.8)
Primary	39	(15.6)
Middle	42	(16.8)
Matriculation	47	(18.8)
Senior Secondary	28	(11.2)
Graduate	12	(4.8)
Total	250	**(100)**
Occupation of the respondents		
Unemployed	42	(16.8)
Farmer	64	(25.6)
Business/industrialist	21	(8.4)
Daily Wager/Labourer	32	(12.8)
Private Service	65	(26)
Government Service	22	(8.8)
Retired/Pensioner	4	(1.6)
Total	250	**(100)**
Monthly income of the household		
Rs 15000 & below	38	(15.2)
Rs 15001- Rs 25000	80	(32)
Rs 25001- Rs 35000	77	(30.8)
Rs 35001- Rs 45000	37	(14.8)
Rs 45001 & above	18	(7.2)
Total	250	**(100)**
Family type of the household		
Joint	195	(78)
Nuclear	55	(22)
Total	250	**(100)**
Family size		

0-5 Persons	48	(19.2)
06-10 Persons	50	(20)
11-15 Persons	81	(32.4)
Above 15 Persons	71	(28.4)
Total	250	**(100)**
Total adult male in the household		
1	49	(19.6)
2	13	(5.2)
3	52	(20.8)
4	49	(19.6)
5	64	(25.6)
More than 5	23	(9.2)
Total	250	**(100)**
Total adult female in the household		
1	56	(22.4)
2	27	(10.8)
3	41	(16.4)
4	84	(33.6)
More then 4	42	(16.8)
Total	250	**(100)**
Total male children in the household		
0	8	(3.2)
1	19	(7.6)
2	60	(24)
3	78	(31.2)
More than 3	85	(34)
Total	250	**(100)**
Total female children in the household		
0	40	(16)
1	54	(21.6)
2	78	(31.2)
3	51	(20.4)
4	22	(8.8)
More then 4	5	(2)
Total	250	**(100)**
Do you have any personal vehicle		
Yes	229	(91.6)
No	21	(8.4)
Total	250	**(100)**
What kind of personal vehicle do you have?		

Two-wheeler	129	(56.33)
Three-wheeler	12	(5.24)
Four-wheeler	88	(38.43)
Total	229	**(100)**

Source: Field survey conducted from December 2020 to January 2021.

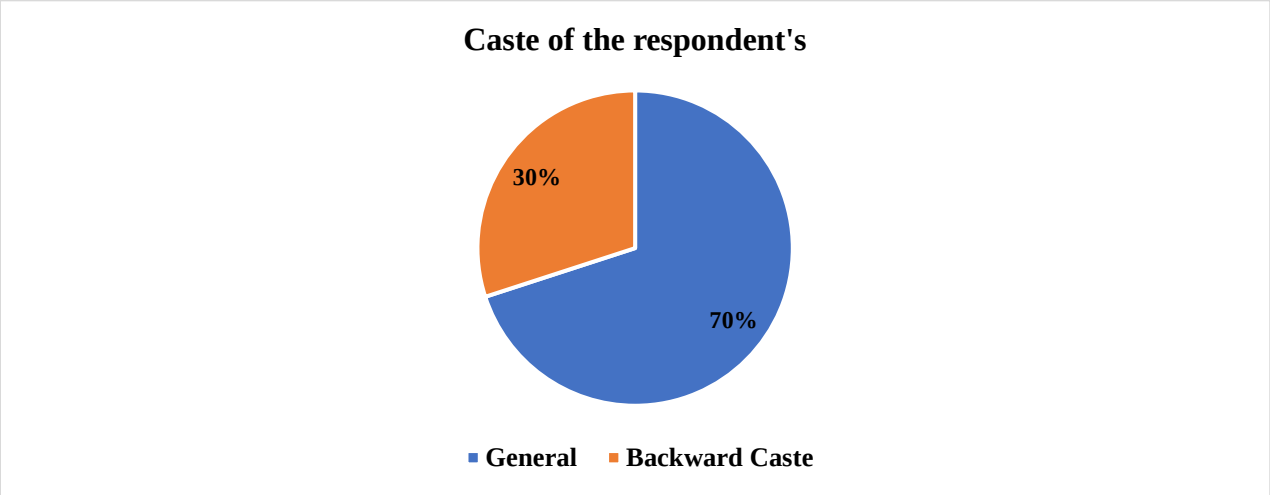
Figure 3.1 Dhanwapur and Basai village: Distribution of respondent's age and years of stay



Source: Field survey conducted from December 2020 to January 2021.

Fig 3.1 presents the pie chart of age and years of stay of the respondents from Dhanwapur and Basai village which are in the vicinity of Basai wetland. The data from the pie chart clearly shows that the majority of respondents were from the age groups 31-40 (35 per cent) and 41-50 (31 per cent) with a 4 percent points difference between the two. A hand full of respondents were from the age group 21-30 years (17 per cent) and below 20 years (5 per cent) with a 12 percent points difference between the two. The remaining 12 per cent of respondents were from the age group above 51 years. Furthermore, the next pie chart shows the number of years respondents were living in Dhanwapur or Basai village. The pie chart shows prominently that half (50 per cent) of the respondents were residing for the last 20 years. One-sixth of the total respondents (16 per cent) were residing for the last 15 years and the maximum was from Dhanwapur village. The remaining 10 per cent, 8 per cent, and 7 per cent were residing from last 10 years, 8 years and 12 years respectively. There is only 3 per cent of the total respondents were residing near the vicinity of Basai wetland for the last 25 years.

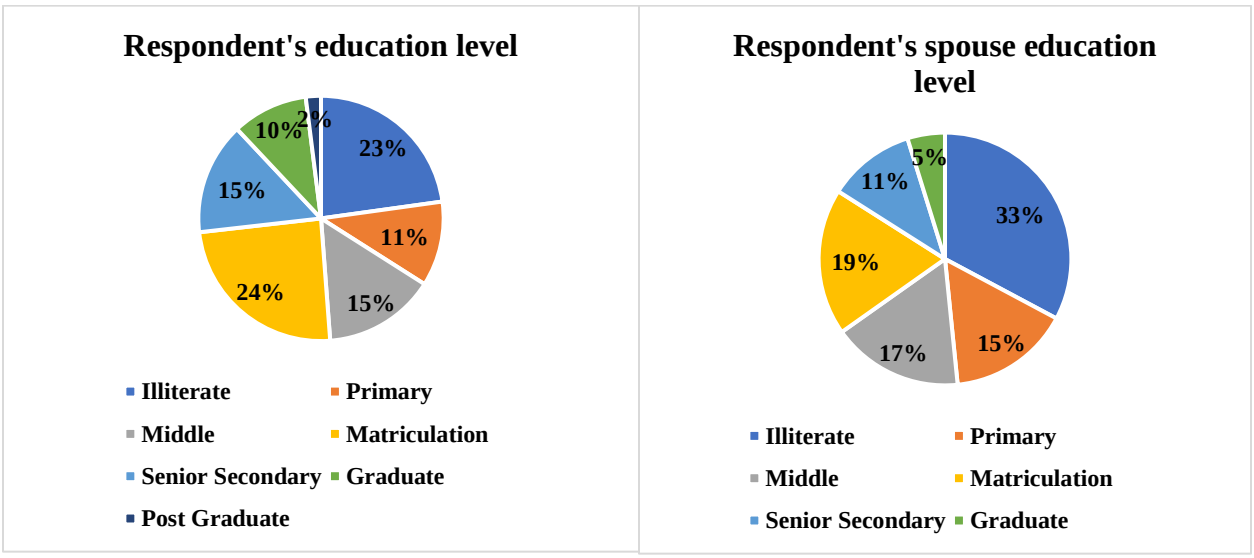
Figure 3.2 Dhanwapur and Basai village: Distribution of respondent's Caste



Source: Field survey conducted from December 2020 to January 2021.

Fig 3.2 presents the pie chart of the distribution of caste in both the villages. The pie chart clearly shows that 70 per cent of respondents were from the general caste, among these most of them were Jaats from Dhanwapur village and the rest were from Basai village. The remaining 30 per cent of the respondents were from backward caste and among these maximums were from Basai village. So, in Dhanwapur village general caste was dominating with mainly Jaats but in Basai all caste were there with a greater number of general castes.

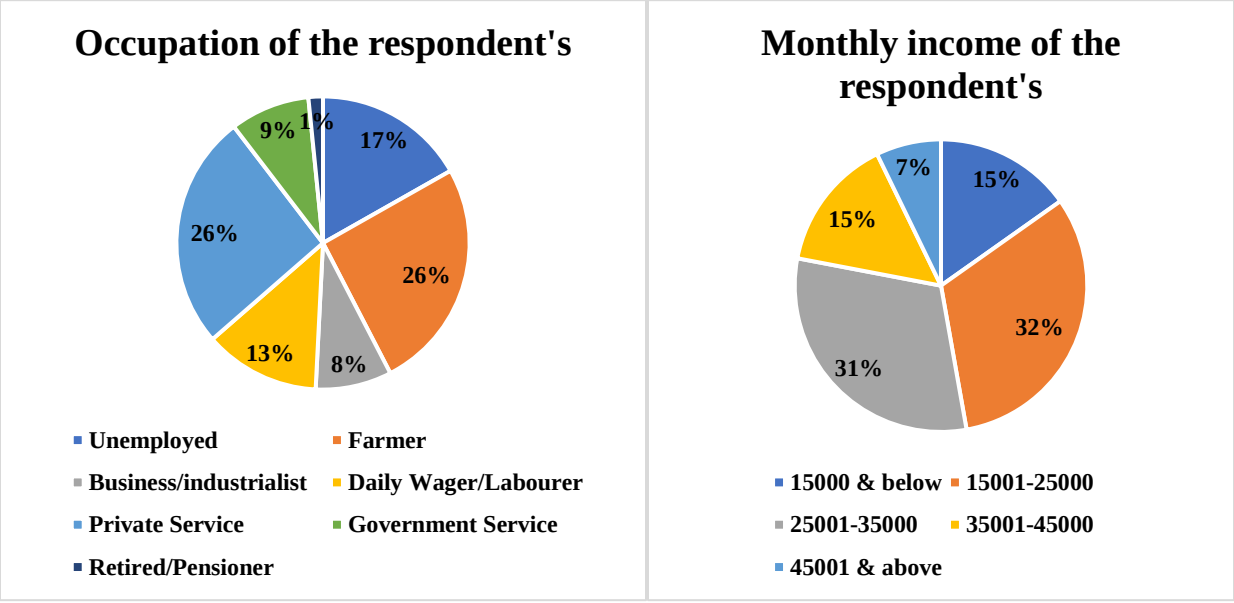
Figure 3.3 Dhanwapur and Basai village: Distribution of respondent's and spouse education level



Source: Field survey conducted from December 2020 to January 2021.

Fig 3.3 presents a comparison of educational levels between the respondents and his spouse for the two villages in the vicinity of the Basai wetland. Literature review shows that the higher the education level of the persons more they are concerned about the environment (Aminrad & et al., 2011). Prominent differences could be seen in the levels of illiteracy and educational attainment at primary, matriculation and postgraduate level. For respondents of the villages, the illiterate population constituted nearly more than one-fifth (22.8 per cent) of the sample population while about one-third (32.8 per cent) of the sample population for respondents' spouses in both the villages were illiterate. The respondents of both the villages had a relatively lower percentage of primary and middle education levels among its sample population which was 4.4 and 2 percent points lower than that of respondent's spouse. However, concerning higher secondary, senior secondary, graduate and postgraduate levels, respondents of both villages had an edge over their spouses (Table 3.2). The most prominent difference was seen at the higher secondary education level (matriculation) where respondents (24.4 per cent) had 5.6 percent points more in the category as compared to that of spouse (18.8 per cent). Another stark difference existed at the postgraduate level where respondents (2 per cent) had 2 per cent points more population belonging to the category and unfortunately 0 per cent of the sample population of respondent's spouse (Fig 3.3). Hence, it can be said that the level of educational attainment was higher in respondents as compared to their spouses.

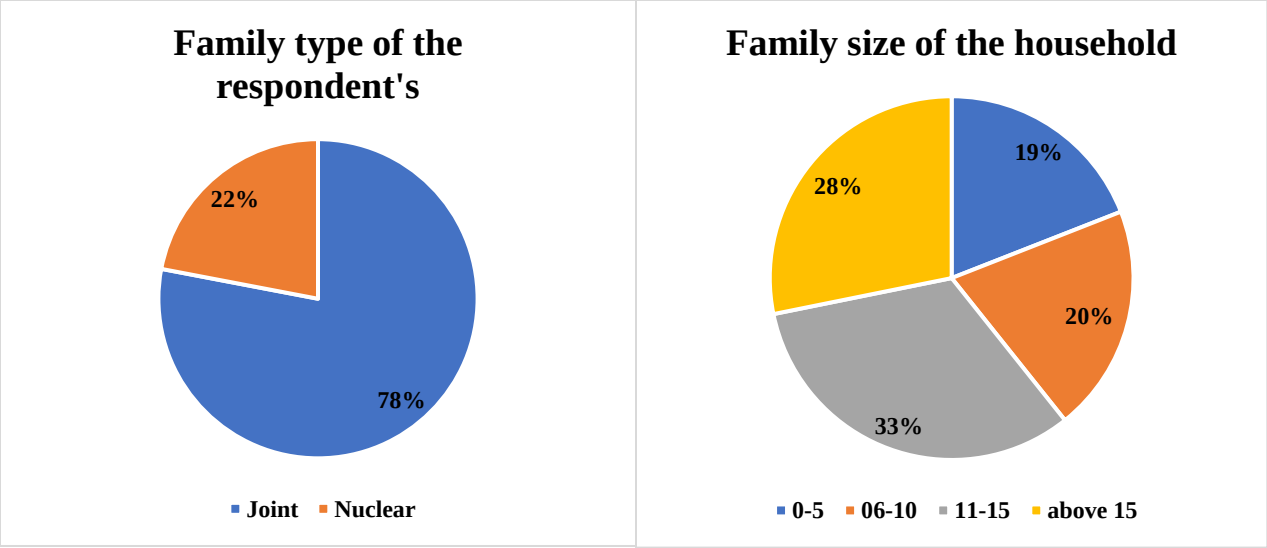
Figure 3.4 Dhanwapur and Basai village: Distribution of respondent's occupation and monthly income.



Source: Field survey conducted from December 2020 to January 2021.

Fig 3.4 presents a comparison of different occupations and the monthly income of the respondents in Basai village and Dhanwapur village. From the pie chart, it is clearly shown that the same percentages of respondents were there in both the villages whose occupation was farmers and private service (26 per cent). The unemployment level was higher (17 per cent) and comes at second place with 9 percent points difference as compared with the first place, farmers and private service occupation in Dhanwapur and Basai villages. 13 percentage of the respondents from both the village were employed as daily wager/ labourers. The remaining 9, 8 and 1 percentage of the respondents were involved in government service, businesses/industrialists or retired/pensioners respectively. Occupation and monthly income are interrelated with each other, based on someone's occupation, his/her monthly income depends. The highest percentage of respondents were getting monthly income within the range either from 15001-25000 (32 per cent) or 25001-35000 (30.8 per cent) with negligible 1.2 percent points difference from both the villages. And nearly the same percentage of respondents were getting monthly income within the range from below 15000 (15.2 per cent) and 35001-45000 (14.8 per cent) with only 0.4 percent points difference between the two. Only 7.2 per cent of respondents from the total population sample were getting a monthly income of more the 45001 and these were mainly from Dhanwapur village.

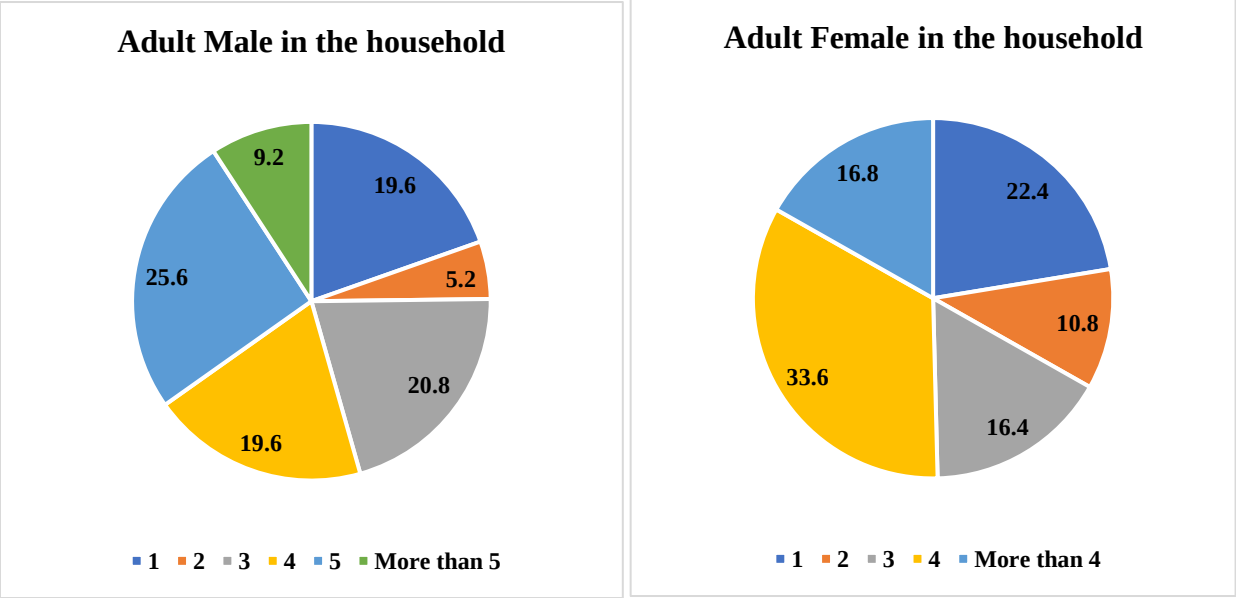
Figure 3.5 Dhanwapur and Basai: Distribution of respondent's family type and size of the household.



Source: Field survey conducted from December 2020 to January 2021.

Fig 3.5 presents the type of families and the total number of persons in the households from Dhanwapur village and Basai village. From the pie chart, it was visible that the maximum number (78 per cent) of households were living in the joint families and it was also observed from the literature reviews that in Haryana most of the families were living in joint families (Sandeep & et. al., 2015). Nearly one-fifth (22 per cent) of the respondent from the population sample were living in nuclear families. Family type is directly proportional with the family size of the household, if the persons living in a joint family their family size will be more. The family size with family members ranges from 11-15 comes highest (32.4 per cent) in the population sample with 4 percent points difference with the family members range from above 15 (28.4 per cent). The family size 06-10 (20.4 per cent) and 0-5 (19.2 per cent) comes third and fourth with a 1.2 percent points difference between the two from Dhanwapur and Basai villages.

Figure 3.6 Dhanwapur and Basai Village: Distribution of adult male and female in the household.

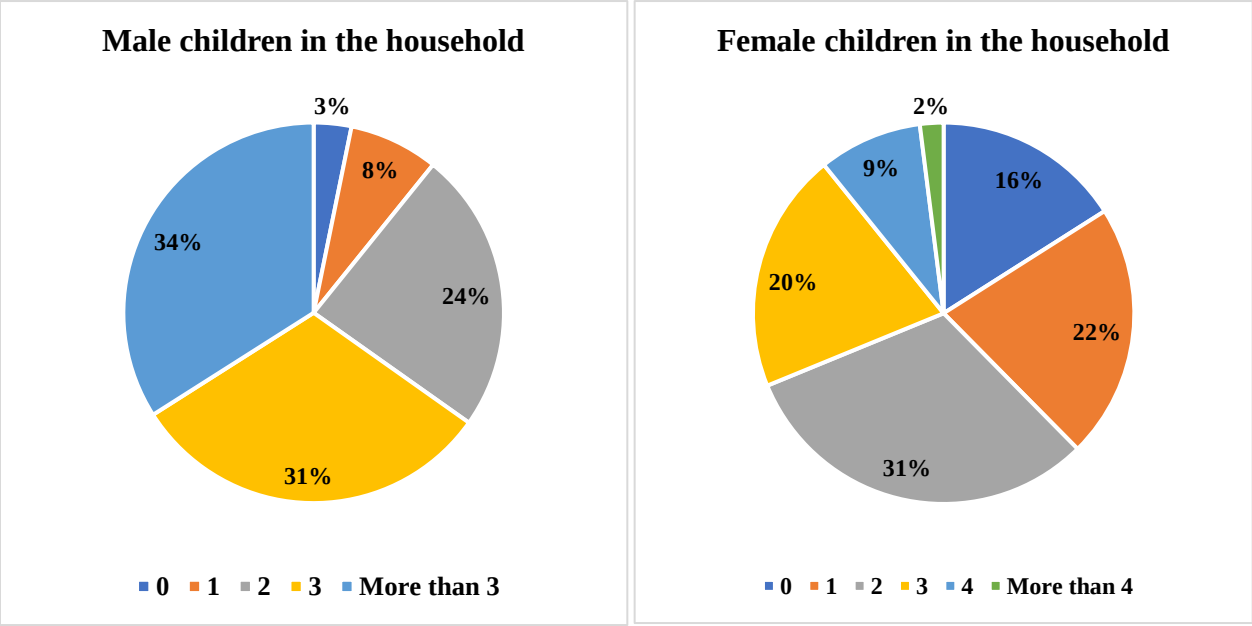


Source: Field survey conducted from December 2020 to January 2021.

Fig 3.6 depicts the comparison of adult males and adult females in the household from Dhanwapur and Basai villages. The prominent difference that could be seen in the number of adult males and adult females was 4, 3 and 2. The maximum difference was 14 percent points in the total percentage of males (33.6 per cent) and females (19.6) in the household was 4. The total percentage of adult males and an adult female was 1 in the household give a 2.8 percent points difference with more

percentage (22.4 per cent) of a single female. The 5.6 percent points difference with the total adult male and an adult female was 2 in the household with more percentage (10.8 per cent) of the adult female. 4.4 percent points difference when the number of total adult male and adult female in the house was 3 with more percentage (20.8 per cent) of an adult male. There were zero households where more the 5 adult females were present but 9.2 per cent of the total population sample were having more than 5 adult male presents in the households.

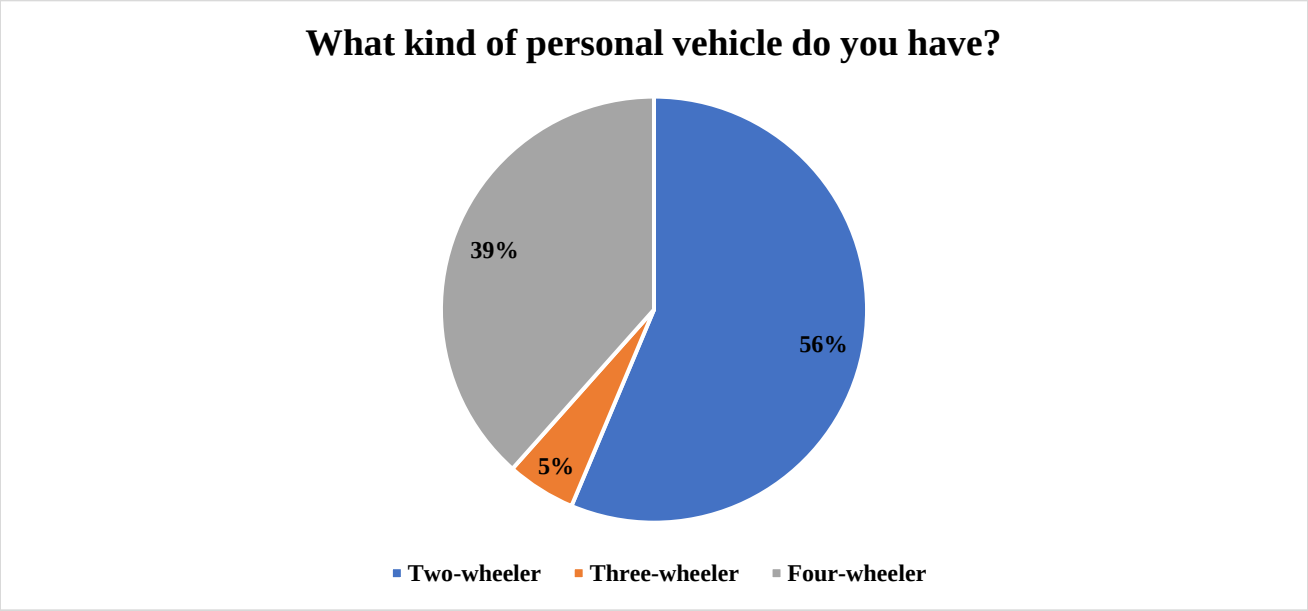
Figure 3.7 Dhanwapur and Basai Village: Distribution of male and female children in the households.



Source: Field survey conducted from December 2020 to January 2021.

Fig 3.7 presents the comparison of male children and female children in the household from Dhanwapur and Basai villages. The prominent difference could be seen in the number of male children and female children were 4, 3 and 2. The maximum difference was 14 percentage points in the total percentage of male children (7.6 per cent) and female children (21.6 per cent) in the household was 1 with a greater number of female children. The second-highest difference was 13 percent points when there were zero male children and female children in the household. 7.2 percent points difference when there were 2 male children and female children in the household with more percentage of female (31.2 per cent) children. 34 per cent of households from the total population sample have more than 3 male children but if we talked about female children more the 4 number was also present during the survey with 2 per cent from the total population sample.

Figure 3.8 Dhanwapur and Basai Village: Distribution of kind of personal vehicle



Source: Field survey conducted from December 2020 to January 2021.

Fig 3.8 presents the pie chart in which kind of personal vehicles were shown for Dhanwapur and Basai villages. More than half (56.3 per cent) of the household were having two-wheelers from the total population sample. Nearly 39 per cent of the household were having four-wheelers as their vehicle and only 5.2 per cent of the respondents were having three-wheelers and these all were given to the drivers for daily wagers as discussed with the respondents.

Table 3.3: Particulars of housing.

House ownership		
	Frequency	**Per centage**
Own	184	(73.6)
Rented	66	(26.4)
Total	**250**	**(100)**
Ownership of the house		
Wife	7	(2.8)
Self	62	(24.8)
Grandfather	19	(7.6)
Father	82	(32.80
Father-in-law	14	(5.6)
Landlord	66	(26.40
Total	**250**	**(100)**

If rented then how much do you pay		
Below 2500	13	(19.7)
2501- 3000	11	(16.7)
3001-4000	34	(51.50
Above 4000	8	(12.1)
Total	**66**	**(100)**
Type of house		
Semi-Pucca	34	(13.6)
Pucca	216	(86.4)
Total	**250**	**(100)**
State the objective of buying/constructing your house.		
For renting	15	(6)
For staying	132	(52.8)
For both staying & renting	103	(41.2)
Total	**250**	**(100)**
Suppose you have to pay monthly house rent for the house you are now living in how much do you pay?		
Rs 5000- Rs 10000	12	(6.52)
Rs 10001- Rs 15000	19	(10.33)
Rs 15001- Rs 20000	40	(21.74)
Rs 20001- Rs 25000	49	(26.63)
Rs 25001 & above	64	(34.78)
Total	**184**	**(100)**
If you are to sell your house, how much would you charge for it?		
Below Rs 1,000/ Sq. ft	14	(7.61)
Rs 1,001- Rs 2,000/ Sq. ft	36	(19.57)
Rs 2,001- Rs 3,000/ Sq. ft	58	(31.52)
Above Rs 3,000/ Sq. ft	76	(41.30)
Total	**184**	**(100)**
How many houses do you have in Basai/Dhanwapur village?		
1	222	(88.8)
2	24	(9.6)
More than 2	4	(1.6)
Total	**250**	**(100)**

Source: Field survey conducted from December 2020 to January 2021.

Table 3.3 depicts the Particulars of housing. The data represented in Table 3.3 shows that respondent ownership of the house had been almost 74 per cent were owned by them rest 26 per cent were rented. 1/3rd of the house ownership was being held by the respondent's father, 26.40 per cent were owned by the landlord, 24.80 per cent owned by the respondents and the rest were owned by wife,

grandfather & father-in-law. Almost 50 per cent of the respondent pay rent between 3001-4000, 16.7 per cent pay between 2501- 3000, 12.1 per cent pay above 4000 & 19.7 per cent pay below 2500. Basic house type falls in the category pucca and semi pucca, 86.4 per cent of respondents were residing in the pucca house and rest in semi pucca. The main objective of buying/constructing house of respondents is for renting and staying whereas 50 per cent of respondents buy or constructed for staying and 41.2 per cent do for both. Almost 1/3rd of the respondent is willing to pay rent above Rs 25001 and only 6.52 per cent are willing to pay between Rs 5000- Rs 10000. Selling a house depends on the amount charged per Sq. ft as per the survey 41.30 per cent respondents will sell their house above Rs 3,000/ Sq. ft, 7.61 per cent below Rs 1,000/ Sq. ft & rest respondent lies in-between.

Table 3.4: Housing (structural) characteristics.

Does your house have		
	Frequency	**Per centage**
Concrete/Brick fencing walls	126	(50.4)
Fencing other than concrete/brick	23	(9.2)
No fencing	101	(40.4)
Total	**250**	**(100)**
The exterior part of your house is mostly made up of		
Concrete	250	(100)
Mud	0	(0)
Total	**250**	**(100)**
The interior walls of the house are made up of		
Panelled /tiles	138	(55.2)
Bricks	112	(44.8)
Total	**250**	**(100)**
The floor of the house		
Marbles/Tiles	192	(76.8)
Concrete	56	(22.4)
Earth	2	(0.8)
Total	**250**	**(100)**
The roof of the house		
Concrete	240	(96)
Tin sheet/asbestos sheet/slate	8	(3.2)
Other than	2	(0.8)
Total	**250**	**(100)**
Please specify the number of bedrooms		
1	12	(4.8)
2	73	(29.2)

3	67	(26.8)
4	78	(31.2)
5	13	(5.2)
More than 5	7	(2.8)
Total	**250**	**(100)**
Please specify the number of living/drawing room		
1	89	(35.6)
2	148	(59.2)
More than 2	13	(5.2)
Total	**250**	**(100)**
Please specify the number of toilets/bathrooms		
1	82	(32.8)
2	72	(28.8)
3	52	(20.8)
4	32	(12.8)
More than 4	12	(4.8)
Total	**250**	**(100)**
Nature of toilet attached		
Yes	178	(71.2)
No	72	(28.8)
Total	**250**	**(100)**
If no toilet, how much more would you pay to have an attached toilet?		
Below Rs10000	21	(29.2)
Rs 10001- Rs 20000	32	(44.4)
Rs 20001- Rs 30000	12	(16.7)
More than Rs 30001	7	(9.7)
Total	**72**	**(100)**
Nature of bathroom attached		
Yes	178	(71.2)
No	72	(28.8)
Total	**250**	**(100)**
If no toilet, how much more would you pay to have an attached bathroom?		
Below Rs 10000	21	(29.2)
Rs 10001- Rs 20000	32	(44.4)
Rs 20001- Rs 30000	12	(16.7)
More than Rs 30001	7	(9.7)
Total	**72**	**(100)**
House length		
40ft & below	24	(9.6)
41ft-50ft	79	(31.6)

51ft-60ft	45	(18)
61ft-70ft	20	(8)
71ft and above	82	(32.8)
Total	**250**	**(100)**
House width		
20ft & below	21	(8.4)
21ft-30ft	82	(32.8)
31ft-40ft	48	(19.2)
41ft-50ft	25	(10)
51ft and above	74	(29.6)
Total	**250**	**(100)**
Please specify the area of the house		
500 Sq. ft & below	78	(31.2)
501 sq. ft- 1000 sq. ft	67	(26.8)
1001 sq. ft - 1500 sq. ft	34	(13.6)
1501 sq. ft - 2000 sq. ft	45	(18)
2001 sq. ft - 2500 sq. ft	16	(6.4)
2500 sq. ft & above	10	(4)
Total	**250**	**(100)**
What is the present age of the house		
5 Years & less	33	(13.2)
6-10 years	58	(23.2)
11-15 years	36	(14.4)
16-20 years	54	(21.6)
21 years & more	69	(27.6)
Total	**250**	**(100)**

Source: Field survey conducted from December 2020 to January 2021.

Table 3.4 depicts the Housing (structural) characteristics for Basai village and Dhanwapur village. The data shows that as per the survey nearly half of the respondent's houses consisted of Concrete/Brick fencing walls and approx. 2/5th of the households had no fencing. Every household had exterior part of the house was made of concrete and nearly half per cent of the interior walls of the houses were made of Panelled /tiles and rest of the houses interior wall was made of bricks.

Out of the total respondents, 3/4th of the households' floors was made of marbles/tiles and approx. 1/5th of the household floor was made of concrete. More than 90 per cent of the houses were having a roof made of concrete and only a few per cent of the houses were tin sheets. Nearly 1/3rd of the households was having 4 bedrooms and the same number goes for 2-bed rooms, maximum of 4

bedrooms was present in the Dhanwapur village and a maximum of 2-bedroom houses were found in Basai village.

More than 6 percentage points of 2/3rd was having the 2 drawing/living room and 1/3 of the total household were having the single drawing/living room. 1/3rd of the total household was 1 toilet/bathroom in their house and nearly 28 per cent of the household were having 2 toilets/bathroom. 1/5th of the total household was having 3 toilets/bathroom and only a few were having 4 toilets/bathroom or more than 4. Nearly 70 per cent of the total household were having attached toilets and only 28 per cent were not have attached toilets. Out of these 28 per cent of the household were not have attached toilets, 2/5th households were ready to pay a sum of Rs 10001- Rs 20000 to build an attached toilet. 30 percentage out of total 72 households were able to pay less than Rs 10000 for an attached toilet and 1/6 of the total 72 households were ready to pay Rs 20001 to Rs 30000 for an attached toilet. Approx. 70 per cent of the total household were having attached bathrooms and only 28 per cent were not have attached bathrooms. Out of these 28 per cent of the household were not have attached bathrooms more than 2/5th of the household was ready to pay a sum of Rs 10001- Rs 20000 to build an attached bathroom. 30 percentage out of a total of 72 households were able to pay less than Rs 10000 for an attached bathroom and 1/6th of the total 72 households was ready to pay Rs 20001 to Rs 30000 for an attached bathroom. Nearly 1/3rd of the houses was having the house length lies between 41ft to 50ft (31 per cent) and a similar number goes for 71 ft (32 per cent) and above. More than 1/6th of the house's length was between 51 ft to 60 ft (18 per cent) and 1/11th of the total houses was between 40 ft & below (9.6 per cent) and 61 ft to 70 ft (8 per cent). 1/3rd of the total house width lies between 21 ft to 30 ft (32.8 per cent) and less than 4 percentage points of 1/3rd lie between51 ft & above house width. 2 percentage less than 1/10th of the total house width lies between 20ft & below (8.4 per cent) and 3 percentage more than 1/6th lies between 31 ft to 40 ft (19 per cent). 1/10th of the total house width lies between 41 ft to 50 ft. one-third of the total houses was having the total area lying between 500 sq. ft & below. More than one-fourth of the area of the total house lies between 501 sq. ft to 1000 sq. ft. Similarly, more than one-eighth of the total house area lies between 1001 sq. ft to 1500 sq. ft. and the rest of the area of the house lies between 1501 sq. ft - 2000 sq. ft, 2001 sq. ft - 2500 sq. ft and 2500 sq. ft & above with 18 per cent, 6.4 per cent and 4 per cent respectively. House stability also depends on the house age where one-eighth of the total house age was five years or less. Less than 2 percentage points of 1/4th of the total age of the house lie between 6 to 10 years and 14 per cent of the total go for 11 to 15 years. 27.6% claims that their house is more than 21 Years or more.

3.4.1 Hedonic Pricing Model Specification

The Hedonic Pricing Model will describe by the following formula:

P= f (DISTANCE, No. B, No. T, HL, HW, AH, P) --1

Where
P= House Price (Dependent Variable)
DISTANCE= Distance of the house to the green area (Basai Wetland)
No. B= Number of Bathroom
No. T= Number of Toilets
HL= House Length
HW= House Width
AH= Total area of the house. (sq. ft)
P= How much payment for the View.

SPSS was used to analyse this formula after taking all the factors. First factor analysis was used and after that Kaiser-Meyer-Olkin (KMO) and Bartlett's Test was applied to get the result.

3.4.2 Factor Analysis

To minimize a large number of variables to a smaller number of factors, a technique was used called factor analysis. The maximum common variance was taken out from all the variables and put into a common score. All these common variances were used for further analyses of the data.

3.4.3 Kaiser-Meyer-Olkin (KMO) and Bartlett's Test

KMO measures the proportion of variance in the variable that might be caused by an underlying factor. KMO tests whether the partial correlations among variables are small. The basic guidelines for KMO values are

1. Less than 0.05 is considered poor.
2. Between 0.5 – 0.6 is considered average.
3. Between 0.6 – 0.7 is considered acceptable.

4. Between 0.7 – 0.8 is considered good.
5. More than 0.8 is considered excellent.

Bartlett's test whether the correlation matrix is an identity matrix (the diagonal value is 1 and off-diagonal values are 0). The condition just means that the variable is completely independent of each other, and thus the factor model is inappropriate. The identity matrix can be ruled out if the p-value of the test is less than 0.005.

Table 3.5 KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.783
Bartlett's Test of Sphericity	Approx. Chi-Square	3713.77
	df	171
	Sig.	.000

Source: Data calculate in SPSS 20.

As we can see from the table 3.5 data, the KMO value is 0.783 which is considered good as it exceeds 0.5. By that, it ensures us this study may conduct a factor analysis. However, Bartlett's test shows 0.000 which is less than 0.005, meaning that the factor that forms the variable is satisfactory. The outcome reveals that there is no high correlation or coefficient among the items.

3.4.4 Total Variance Explained

It is the percentage of the total variance among the variables that can be explained by a single factor. If the variables are independent of each other than the total variance will be equal to the number of variables in the analysis. Eigen value is used to decide the number of factors.

Table 3.6 Total variance explained

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.621	40.111	40.111	5.388	28.358	28.358
2	2.271	11.955	52.066	3.491	18.376	46.734
3	1.899	9.994	62.06	2.569	13.519	60.253
4	1.278	6.728	68.788	1.439	7.574	67.827

5	1.012	5.327	74.115	1.195	6.288	74.115
6	0.82	4.317	78.432			
7	0.742	3.904	82.336			
8	0.581	3.057	85.394			
9	0.489	2.575	87.969			
10	0.472	2.482	90.451			
11	0.384	2.022	92.473			
12	0.363	1.91	94.383			
13	0.295	1.555	95.938			
14	0.264	1.392	97.329			
15	0.207	1.087	98.417			
16	0.158	0.829	99.246			
17	0.115	0.605	99.851			
18	0.025	0.132	99.983			
19	0.003	0.017	100			
Extraction Method: Principal Component Analysis.						

Source: Data calculated in SPSS 20.

From Table 3.6 we can see that the total variance explained is 74.115 per cent where the first factor determines 28.358 per cent of the variance. The second factor provided an 18.376 per cent of the total variance, the third and fourth determines accordingly 13.519 and 7.574 per cent of the variance and finally, the fifth factor determines the 6.288 per cent of the total variance.

Table 3.7 Unstandardized and Standardized Coefficients

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	14.963	0.01		1521.62	.000
	Housing Characteristics	0.115	0.01	0.403	14.701	.000
	How Much Would you like to pay for National Parks? (Rs)	0.019	0.01	0.092	1.926	.056
	How Much would you like to pay for wetlands and view for wetlands? (Rs)	0.137	0.01	0.568	3.772	.000

	Approximate distance from forests and view for forests	-0.008	0.01	-0.038	-0.789	.431
	Approximate distance from wetland and public parks (meter)	-0.142	0.01	-0.645	-0.05	.002
a. Dependent Variable: House Price						

The unstandardized Coefficient would be taken if the values are the same but for this research, logs have been taken to equate the values in one format. According to the analysis of data, the housing characteristics, payment for the view for the wetlands and approximate distance from the wetland and public park show a great impact on the housing price and they are also having a good significant level. The Standardized Coefficient for the approximate distance from wetland is -0.645. The negative value shows that the total house price decrease if the distance increase from the Basai Wetland.

3.5 SUMMARY AND CONCLUSION

Wetlands are deteriorating day by day throughout the world even after so many conferences/agreements and the pledge was taken by UN countries. This is happening because no human being cared about wetlands and their benefits. Today everyone needs money and want to live a lavish life, forgetting about the global temperature rise and the stress upon the natural resources. To divert the minds of people towards the economic benefits of natural resources specially Wetlands, many valuations techniques were invented by different scientists globally. This thesis is based on these valuation techniques i.e., CVM and HPM for Basai wetland which is in Gurugram. The CVM for Basai wetland was calculated in chapter 2 and this chapter was based on HPM.

The total economic value of the Basai wetland was analysed by using the (Barbier, Acreman, & Knowler, 1997) model of Use Value and Non-use Value. For use-value Contingent Valuation Method was used and for the Non-use Value Hedonic Pricing Model was used.

The CVM was used to gather the public perspective for willingness to pay for the conservation and maintenance of the ecosystem services. The structured questionnaire was framed and face to face interviews was held to know the willingness to pay from the public living near to the wetland. The people living adjacent to the Basai wetland were eagerly wanted to save the wetland because of this their willingness to pay the amount was high.

The importance and benefits of the Basai wetland were discussed with every respondent and their perspective was noted like many respondents were demanded to create proper fencing around the

wetland. Some of the respondents were agreed to create a recreational activity place in the Basai wetland and some wanted to clean the water of the wetland so that they can go on a morning or evening walk along the wetland. As Basai is an urban wetland and most of the people were landlords and their economic conditions was good and because of this they happily wanted to give money for the conservation and management of Basai wetland. For CVM 250 households were selected and interviewed from Dhanwapur and Basai village and the average willingness to pay the amount collected was Rs 832 per month.

The HPM was used to know the variation in house prices by different environmental services. The nearness to the Basai wetland costs the house price more as compared to the house that is far away from the Basai Wetland. For HPM again 250 households were selected and interviewed from Dhanwapur and Basai village. These two villages were selected because they were adjacent to the Basai Wetland. The regression analysis was done to know the effect of distance for the Basai wetland on the total house price. As accepted the distance from the Basai wetland to the house price show a significant effect. The analysis shows that an increase of 1 meter further away from the Basai wetland drops the total house price by Rs 645 and this is can be considered as a high impact. In all, we can say that the ecosystem services show a positive impact on house price so it is also an important part of the city's development.

The Total Economic Value of the Basai wetland was calculated by adding the value of CVM and HPM and the value is Rs 1477 which is a very huge value as it was observed in the different literature reviews (Abraham, 2004) (Ramachandra, Rajinikanth, & Ranjini, 2005).

CHAPTER 4

AN ANALYSIS OF LAND USE AND LAND COVER CHANGE DETECTION FOR BASAI WETLAND

4.1 INTRODUCTION

The physical characteristics of Earth's surface like forests, rivers, mountains, soil etc are termed as Land Cover and the use of Earth's surface by Humans for their benefits is described as Land Use. The data of land cover shows that how much a region is covered by mountains, wetlands, rivers, forests agriculture and other physical present features. Land use data shows that how much landscape is used by humans for different purposes like development, settlement, conservation, urbanisation etc These two terms i.e., Land Use and Land Cover (LU/LC) are interchangeable sometimes like if we talk about settlement then it will be referred to as Land Cover but if we further describe the settlement of buildings then it will refer to Land use (Kaul & Sopan, 2012)..

The understanding of the Earth's surface gives a direction of climate change. Studies from the 1970s show that land cover influences the Earth's surface albedo, which changes the atmospheric energy and then leads to regional climate impact (Otterman, 1974). A much wider range of influence of Land use land cover changes on environmental services was further recognised through the world (Sala & et al, 2000). Anthropogenic activities are the prime source for the change in LU/LC which has become a focal point at regional, national and global levels for the change in environment services (Lambin, Geist, & Lepers, 2003). The study of LU/LC shows a vital role to detect the change in environmental services and then it will be processed to make the policies associated with natural resource management.

The data analysed by the LU/LC changes shows utmost importance for environmental and socio-economic relevance. The impact of LU/LC changes will give the reference of urbanisation, loss of natural resources like wetlands, ponds, rivers, lakes, forest area, loss of migratory species, desertification of soil, increase in agricultural land, deforestation etc (Verburg, et al. 2000).

Change is inevitable so cities are growing at a very high rate. Expansion of city due to urbanisation and increasing agriculture activities exploiting the ecological balance. Globally ecological services are affected by anthropogenic activities. Wetlands play the role of the lung for ecological services as they filter the air by the process called carbon sequestration which was further discussed in chapter 5.

4.1.1 LAND USE LAND COVER AND ITS ECONOMIC IMPACT

Economic activity monitoring is critical for understanding economic situations and assisting policymakers in developing and managing sustainable development and management strategies (Cao, Wu, Huang, & Liu , 2020). Given that economic activities modify the Earth's surface over time, data that disclose these changes can enable regular and large-scale observations of economic activity, which could significantly improve comprehension of the current economic situation and trend forecast (Wu & et al, 2013). Traditional data gathering methods, such as mapping and questionnaires, have been used for a long time and these methods are costly and time-consuming. In addition to the data is not updated and it is difficult to approach (Parsa & Salehi, 2016). Remotely sensed images, which provide an up-to-date and realistic representation of the Earth's surface, are a strong implementation of economic activity monitoring study. Due to its fast and wide-range imaging capability, remote-sensing technology is a useful way of studying surface changes on the Earth (Chen & et.al., 2019).

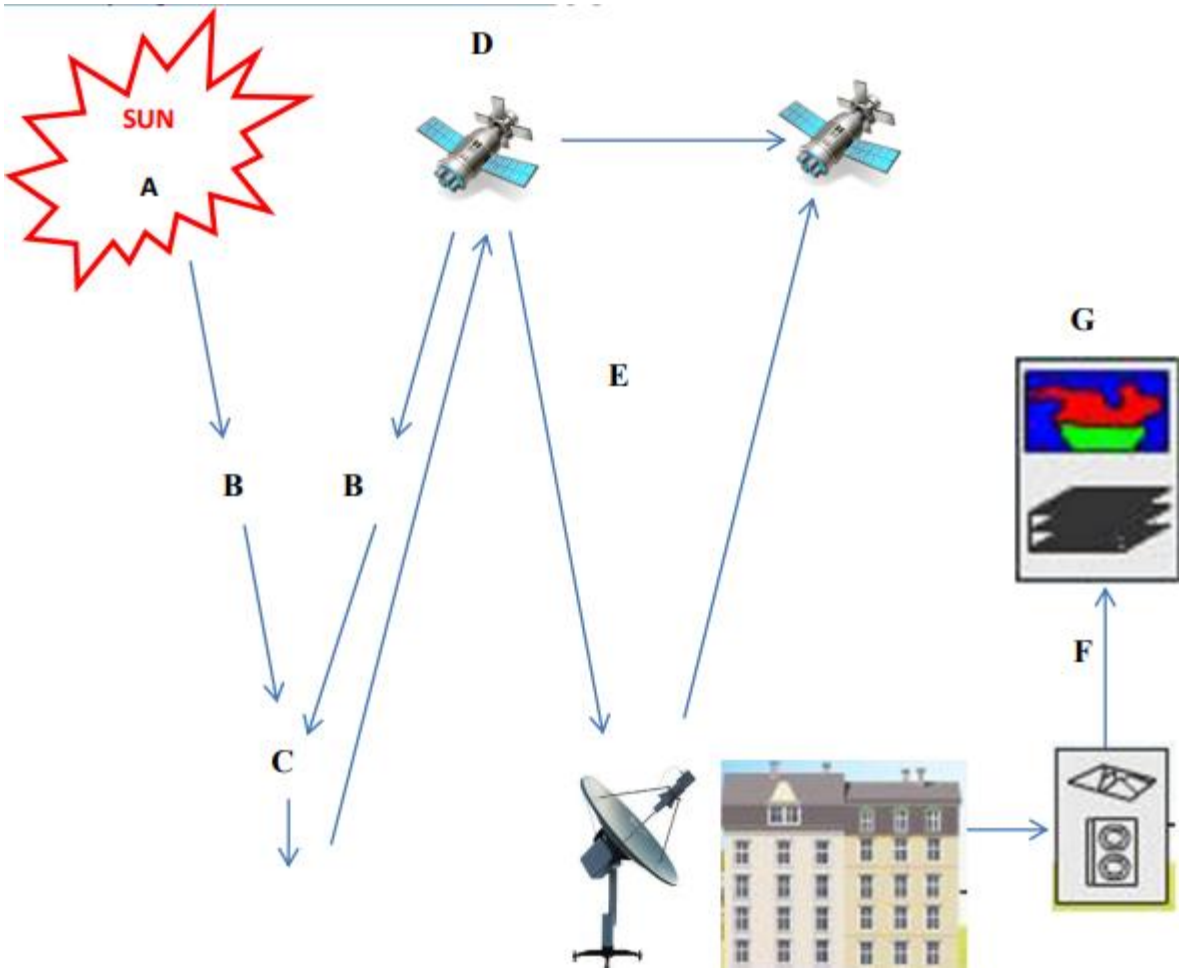
The role of LU/LC change detection for wetlands is important in terms of calculating the economic value. The land use value is directly proportional to the economic value of the wetlands. As discussed in the last two chapters that there was a total economic value for the Basai wetland implies that every natural resource, humans use for their benefit were having some economic value. The main disadvantage is the method of calculating the economic value for the wetlands as it requires a tedious primary survey. However, the land use land cover change detection technique can also be used to analyse the economic value of the wetlands. The volume of water a wetland can hold or the quantity of carbon that can be sequestered by the wetland can generate the economic value of the wetlands.

4.2 GEOGRAPHICAL INFORMATION SYSTEM & REMOTE SENSING

In the past, when computers and remote sensing didn't exist, the LU/LC change was detected using tracing paper and a topographic sheet. But this method was time-consuming and labour intensive for larger areas and cost a lot of effort. Previous mapping methods were job dependent and less accurate. Therefore, with this technology, it is easier to create a LU/LC map and detect changes at regular intervals, especially in areas where we cannot walk manually, that is, inaccessible areas. Therefore, this method is suitable for accessing critical areas and monitoring their periodic changes. To

understand the reality of the site, we need to create the maps from statistics generated by algorithms that require GIS software like Arc GIS, Google Earth Pro, QGIS etc.

Image 4.1 Procedure of Remote Sensing



Source: 10_chapter 1.pdf (inflibnet.ac.in)

A) **Energy source and illumination:** The sun is the most common source of energy for passive remote sensing. The satellite sensor mainly records the radiation that is reflected off the target. Remote sensing in the visible part of the electromagnetic spectrum is an example of passive (reflected) remote sensing.

B) **Atmosphere & radiation:** As energy travels from its source to its destination, it will come into connection and interact with the atmosphere through which it passes. As energy flows from the target to the sensor, a second interaction may occur.

C) **Interaction with the Goal**: When energy passes through the atmosphere and reaches the target, it interacts with the target based on the qualities of both the target and the radiation.

D) **Recording of energy by the sensor:** We need a sensor (that isn't in contact with the target) to receive and record the electromagnetic radiation after it has been scattered or released by the target.

E) **Transmission, Reception, and Processing:** The energy recorded by the sensor must be transmitted, often electronically, to a receiving and processing station, where the data is processed into an image (paper and/or digital).

F) **Interpretation and Analysis:** The processed image is interpreted visually and/or digitally or electronically to extract information about the illuminated target.

G) **Application:** The final component of the remote sensing procedure is attained when we apply the information, we were able to obtain from the images to the target to better understand it, reveal new information, or help solve a specific problem.

These seven elements cover the remote sensing process from start to finish.

4.3 DATA SOURCE AND METHODOLOGY

The images used for LU/LC change detection have been downloaded by paying money from a commercial website that used the GeoEye-1 satellite for taking earth images. The GeoEye-1 satellite; is a very high resolution (VHR) Earth-observing commercial satellite from the USA with an orbital altitude of 681 km. The geometric resolution for panchromatic is 0.41m and for multispectral is 1.65m. The image has oriented using the Maximum Likelihood (ML) model supervised in Arc GIS 10.4 software with proper ground-truthing to identify the LU/LC change for the Basai wetland.

The area of the Basai wetlands is 312.06 Ha as this was taken by the report from Delhi Bird Foundation (DBF) and also by the discussion with the founder of this organisation Nikhil Devasar. The ground survey was also held in the year 2017, 2018 and 2019 to know the site facts. The Bombay Natural History Society (BNHS) and Birdlife International had designated Basai wetland under Important Bird Area (IBAs) and the site code is IN052 (ENVIS, 2016). Basai Wetland is the home of many bird species, fishes and turtles. Nearly 243 different bird species were found in the Basai wetland (ENVIS, 2016).

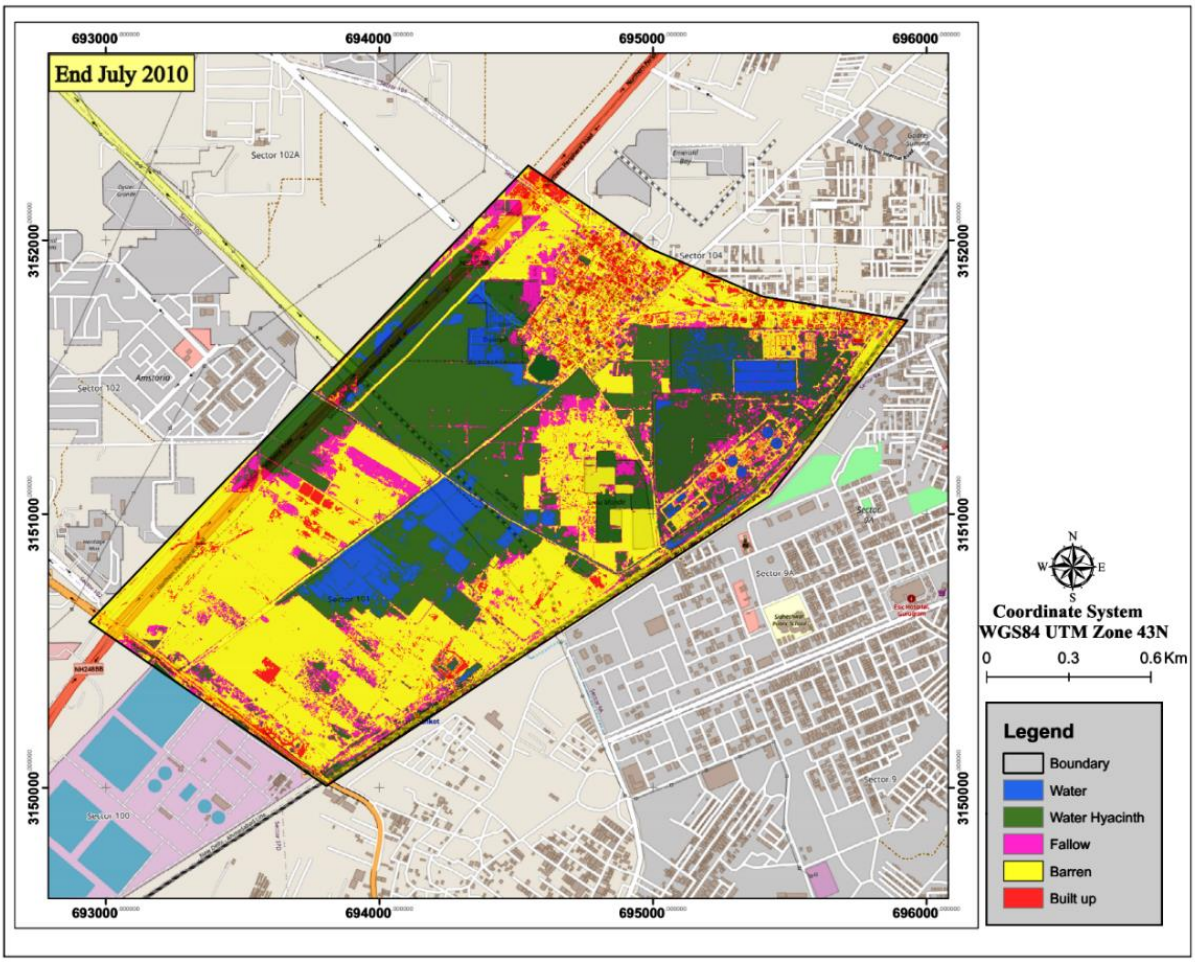
4.3.1 ACCURACY ASSESSMENT

For making the LU/LC map the most important step is Quality evaluation (Giri, 2012). Therefore, to check the accuracy of the LU/LC map and their classification for 2010, 2012, 2014, 2016, 2018 and 2020, Google earth image and Ground Control Points (GCP) were taken. 35 Ground Control Points (GCP) were taken randomly with the help of a Gramin GPS etrex10 for 2018 and 2010, 2012, 2014, 2016 and 2020 Ground Control Points (GCPs) were generated using Google earth images and Arc GIS 10.4.

4.4 RESULT AND ANALYSIS

The LULC images were downloaded from the GeoEye-1 commercial website and processed in the Arc GIS 10.4 software for knowing the LU/LC change over ten years from 2010 to 2020. A maximum likelihood model was used. The estimator maximises the likelihood for the given parameter. The statistical analysis of multi-temporal LU/LC maps of Basai wetland presents a significant change that has taken place from 2010 to 2020. Table 4.7 shows the value of LU/LC change in Basai wetland during 2010, 2012, 2014, 2016, 2018 and 2020. The land-use change by many anthropogenic activities over a while in Basai wetland shows conversion of the physical environment in the area. The rapid urbanisation has significantly altered the natural landscape of the area near Basai wetland. The prominent changes could be seen in the water area, water hyacinth, fallow land, barren land and built-up area.

Figure 4.1 The land use land cover classification map of Basai wetland in 2010



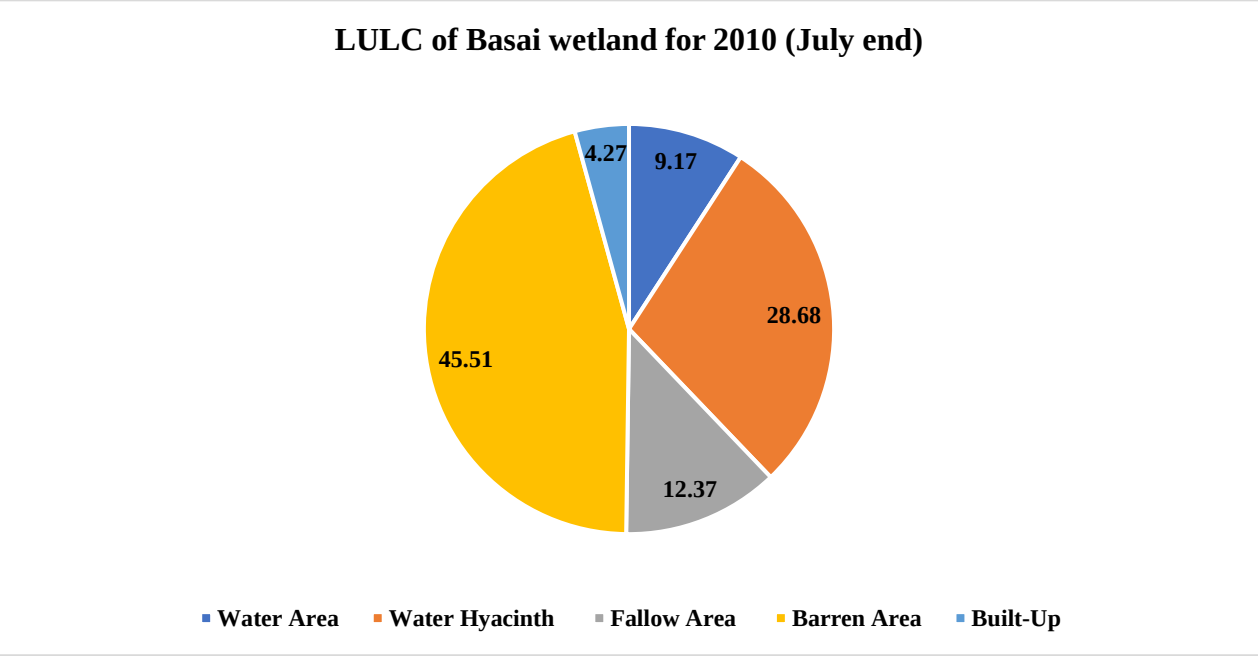
Source: Digitised in Arc GIS 10.4 software.

Table 4.1 LU/LC of Basai wetland for 2010 (July end)

	Frequency	Per cent
Water Area	28.62	9.17
Water Hyacinth	89.49	28.68
Fallow Area	38.61	12.37
Barren Area	142.01	45.51
Built-Up	13.33	4.27
Total Area (Ha)	**312.06**	**100**

Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

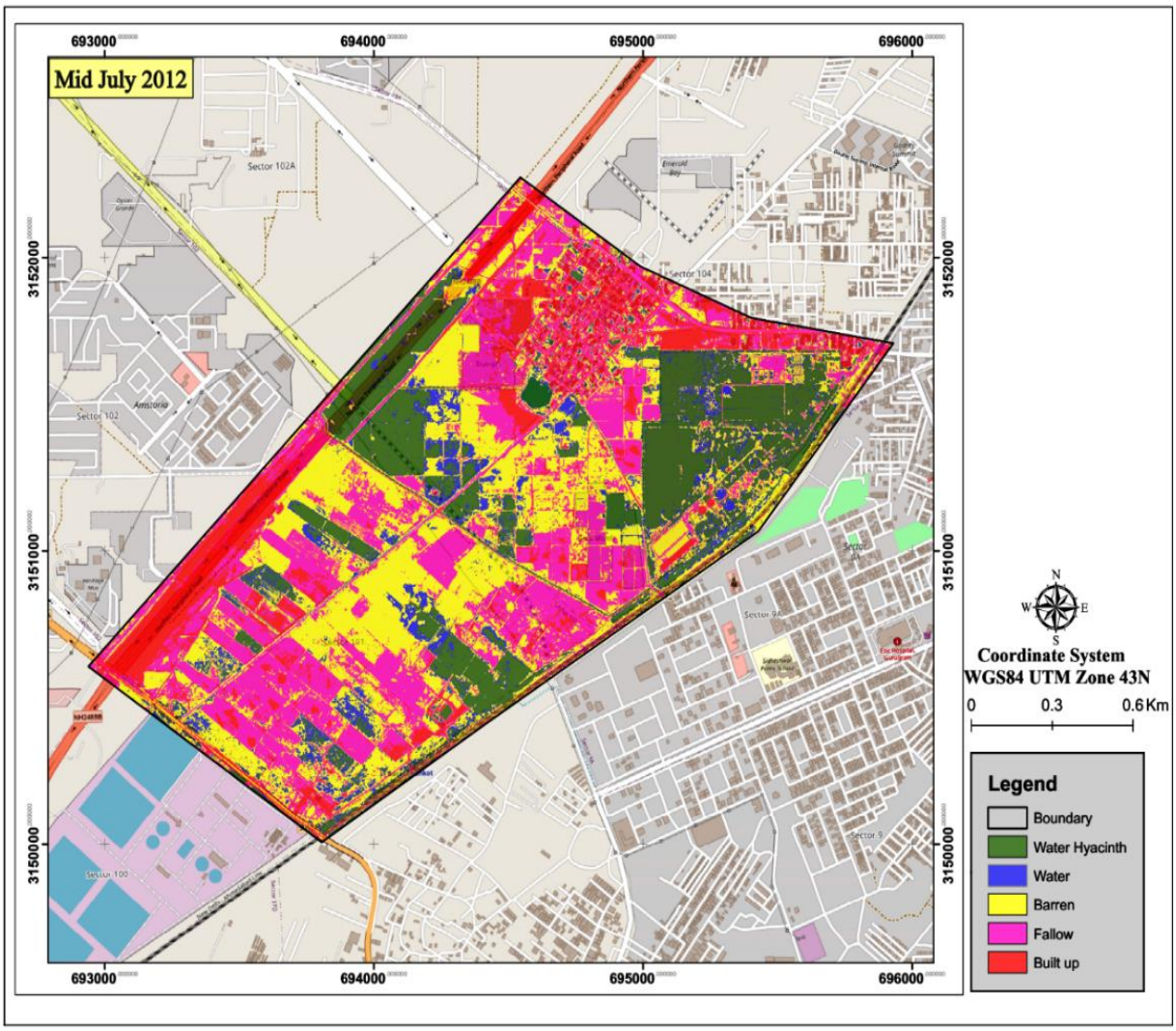
Figure 4.2 Distribution of LU/LC of Basai wetland (2010)



Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

Fig 4.2 depicts the LULC distribution of Basai wetland for the year 2010 end of July. The data reveals that the maximum area under the wetland was barren land which accounted for more than two-fifths of the total area (45.51 per cent). More than one-fourth of the total area (28.68 per cent) was covered with the growth of water hyacinth. Nearly one-tenth of the total area (12.37 per cent) was barren land while less than one-tenth of the area (9.17 per cent) was underwater (Fig. 2). On average, the highest rainfall from southwest monsoons falls in August in the northwest Indian region, hence, this explains the less water area during this period. The built-up area covered the minimum portion of the total area of the wetland which accounted for a meagre 4.27 per cent implying that the entire wetland was an open area with minimum human intervention.

Figure 4.3 The land use land cover classification map of Basai wetland in 2012



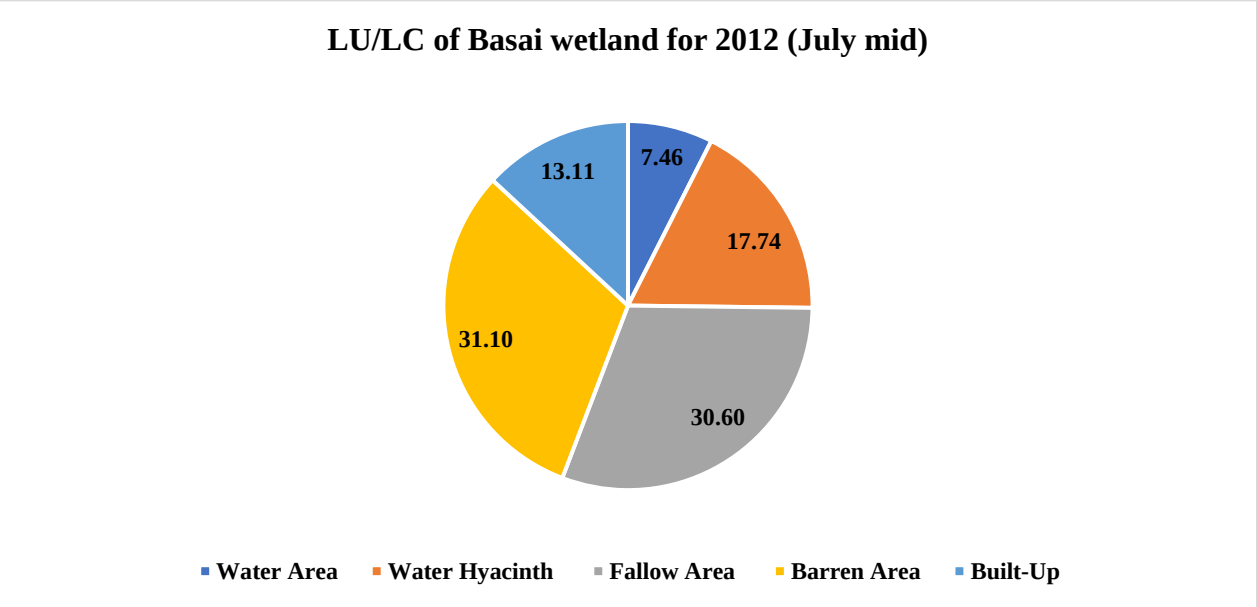
Source: Digitised in Arc GIS 10.4 software.

Table 4.2 LU/LC of Basai wetland for 2012 (July mid)

	Frequency	Per cent
Water Area	23.28	7.46
Water Hyacinth	55.35	17.73
Fallow Area	95.49	30.59
Barren Area	97.04	31.09
Built-Up	40.9	13.10
Total Area (Ha)	**312.06**	**100**

Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

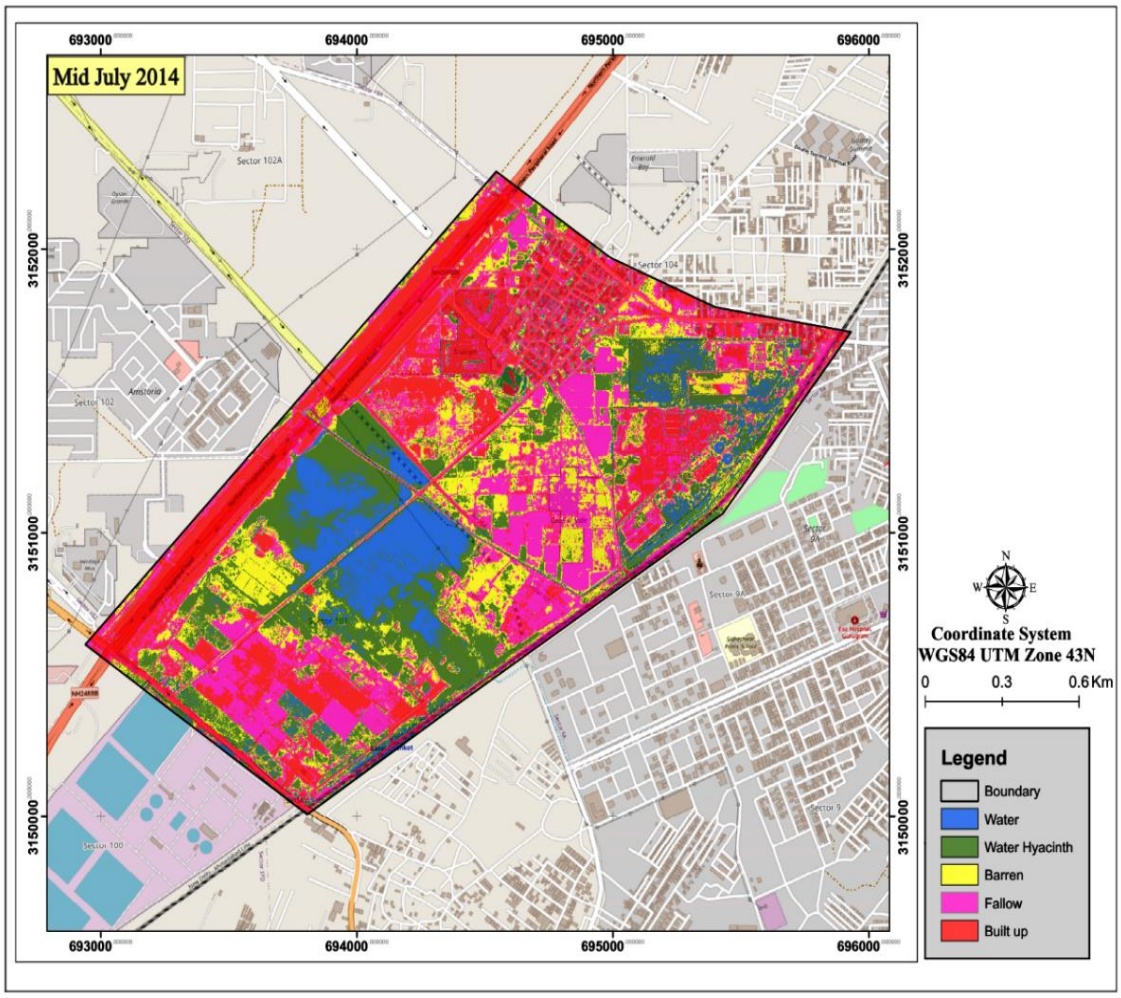
Figure 4.4 Distribution of LU/LC of Basai wetland (2012)



Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

Fig 4.4 depicts the LU/LC distribution of Basai wetland for the year 2012 mid of July. The data reveals that the maximum area under the wetland was a tie between barren land (31.10 per cent) and fallow area (30.60 per cent) with only a 0.5 percentage points difference. More than one-sixth of the total area (17.74 per cent) was covered with the growth of water hyacinth. More than one-eighth of the total area (13.11 per cent) was a built-up area while less than one-thirteenth of the area (7.46 per cent) was an underwater area (Fig. 4.4). On average, the highest rainfall from southwest monsoons falls in August in the northwest Indian region, hence, this explains the less water area during this period.

Figure 4.5 The land use land cover classification map of Basai wetland in 2014



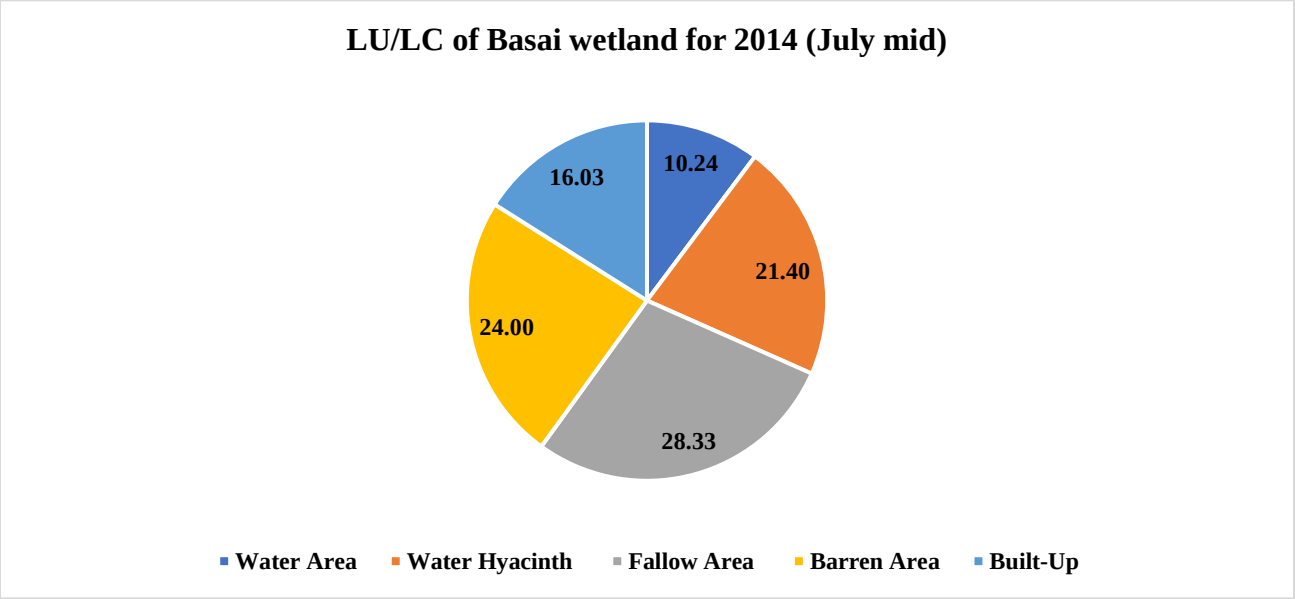
Source: Digitised in Arc GIS 10.4 software.

Table 4.3 LU/LC of Basai wetland for 2014 (July mid)

	Frequency	Per cent
Water Area	31.95	10.23
Water Hyacinth	66.79	21.40
Fallow Area	88.41	28.33
Barren Area	74.88	23.99
Built-Up	50.03	16.03
Total Area (Ha)	**312.06**	**100**

Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

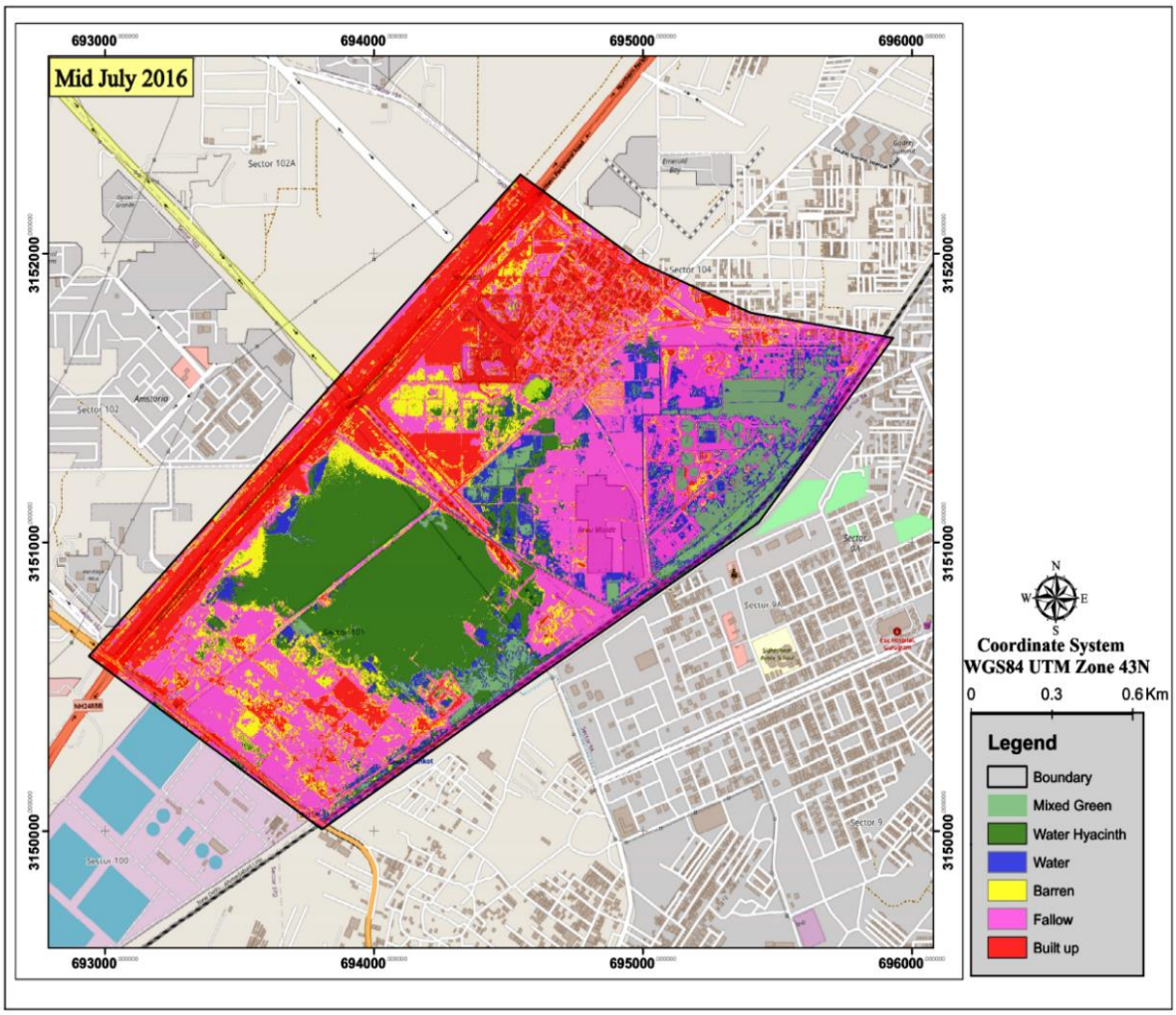
Figure 4.6 Distribution of LU/LC of Basai wetland (2014)



Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

Fig 4.6 depicts the LU/LC distribution of Basai wetland for the year 2014 mid of July. The data reveals that the maximum area under the wetland was fallow land which accounted for four percentage points more than one-fourth of the total area (28.33 per cent). One percentage less than one-fourth of the total area (24.00 per cent) was covered with the barren area. Nearly 1.4 percentage points more than one-fifth of the total area (21.40 per cent) was water hyacinth while less than one-sixth of the area (16.03 per cent) was under built-up area (Fig. 4.6). The water area covered the minimum portion of the total area of the wetland which accounted for a meagre 10.24 per cent.

Figure 4.7 The land use land cover classification map of Basai wetland in 2016



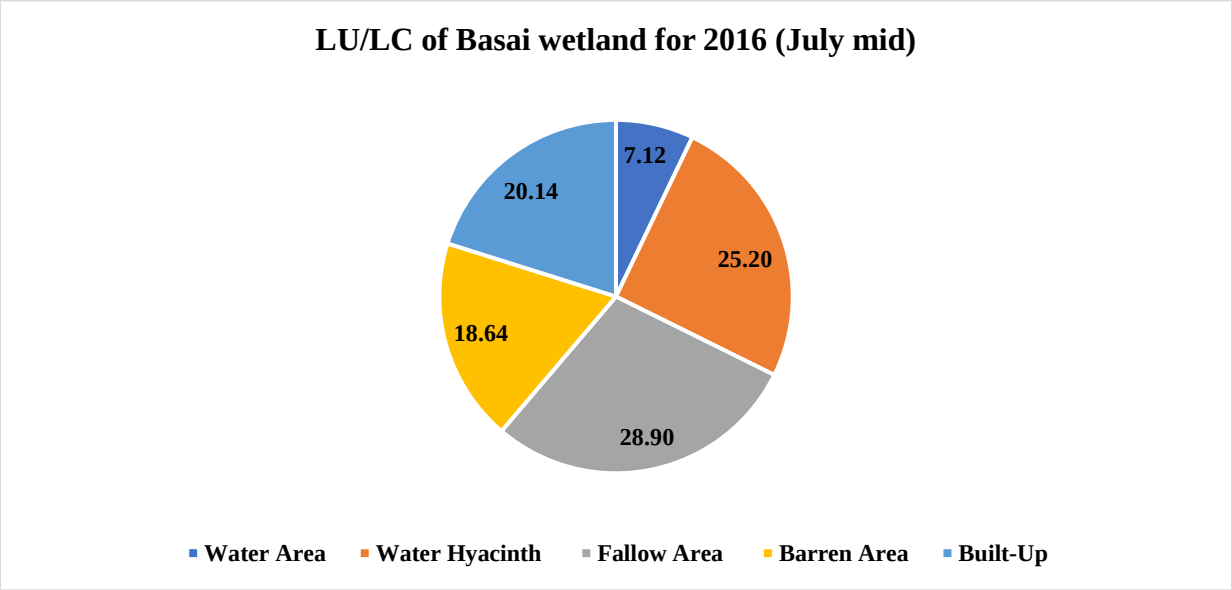
Source: Digitised in Arc GIS 10.4 software.

Table 4.4 LU/LC of Basai wetland for 2016 (July mid)

	Frequency	**Per cent**
Water Area	22.21	7.11
Water Hyacinth	78.65	25.20
Fallow Area	90.19	28.90
Barren Area	58.16	18.63
Built-Up	62.85	20.14
Total Area (Ha)	**312.06**	**100**

Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

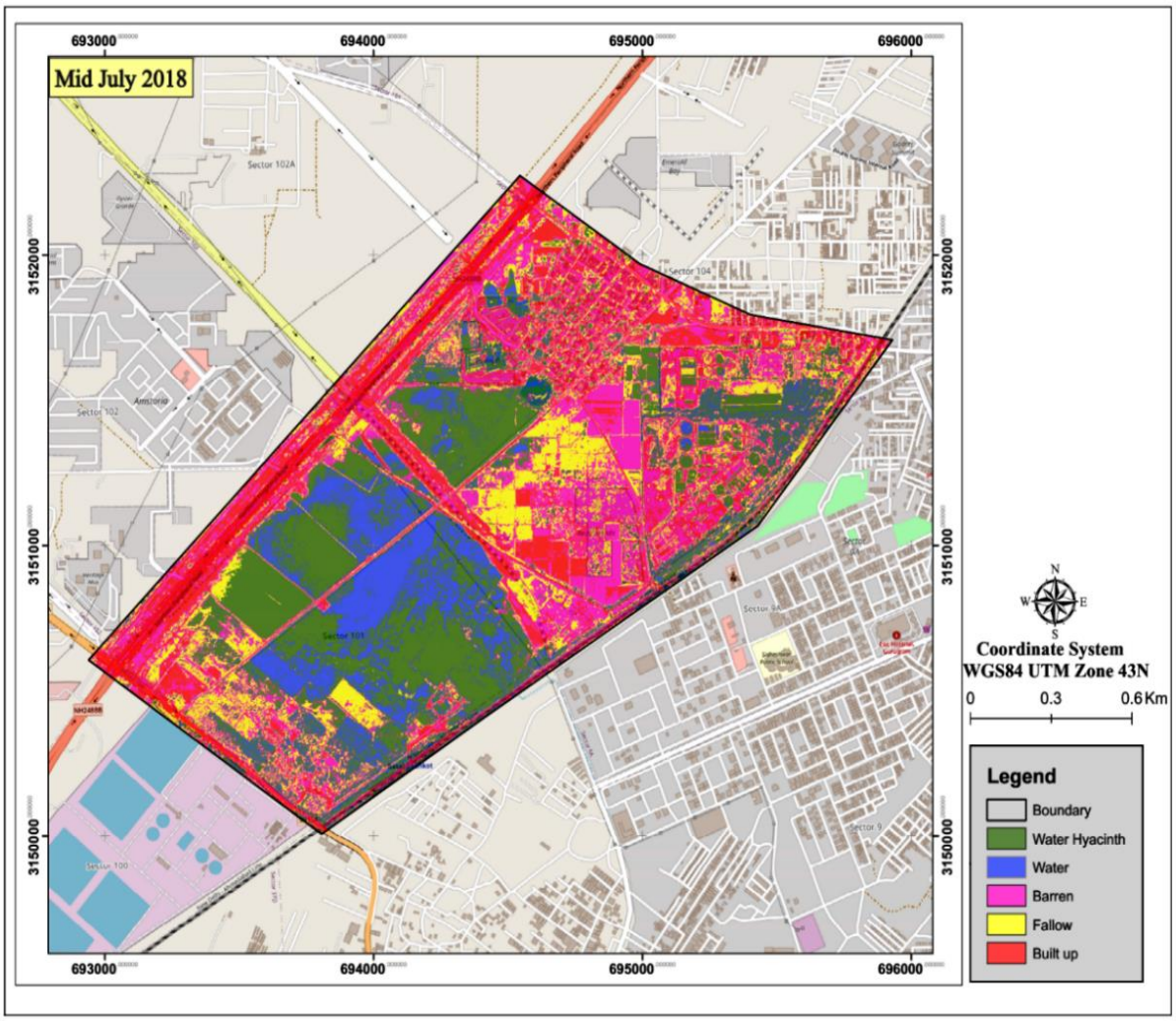
Figure 4.8 Distribution of LU/LC of Basai wetland (2016)



Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

Fig 4.8 depicts the LU/LC distribution of Basai wetland for the year 2016 mid of July. The data reveals that the maximum area under the wetland was fallow land which accounted for 3.9 percentage points more than one-fourth of the total area (28.90 per cent). More than one-fourth of the total area (25.20 per cent) was covered with the growth of water hyacinth. Nearly one-fifth of the total area (20.14 per cent) of the wetland was built-up area while 1.3 percentage points less than one-fifth of the area (18.64 per cent) was under barren area (Fig. 4.8). The water area covered the minimum portion of the total area of the wetland which accounted for a meagre 7.12 per cent implying that the entire wetland.

Figure 4.9 The land use land cover classification map of Basai wetland in 2018



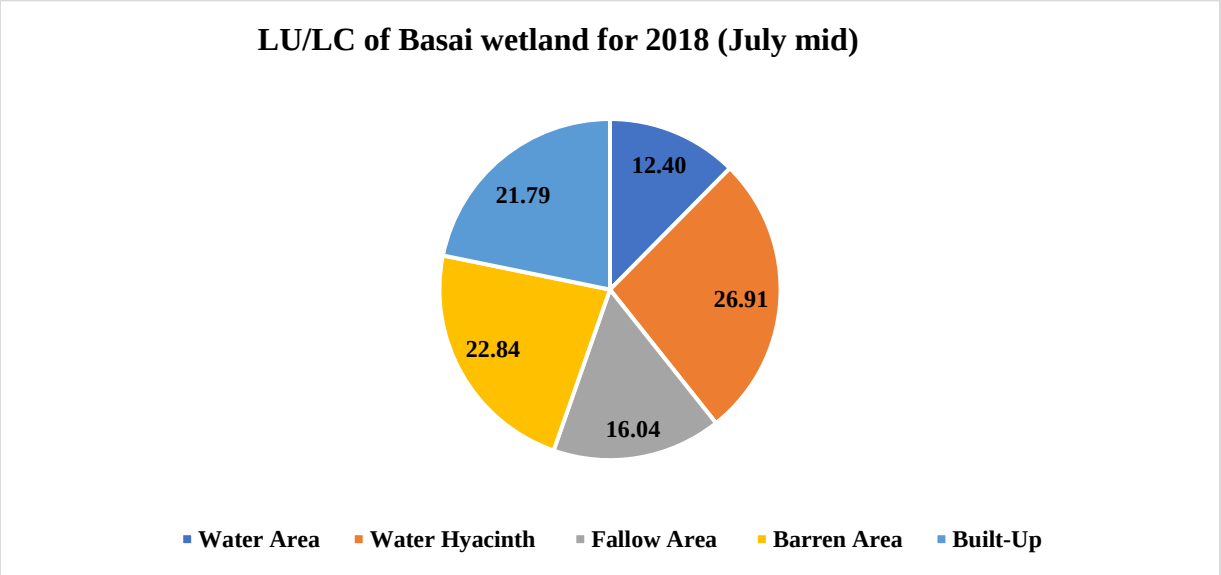
Source: Digitised in Arc GIS 10.4 software.

Table 4.5 LU/LC of Basai wetland for 2018 (July mid)

	Frequency	Per cent
Water Area	38.71	12.40
Water Hyacinth	83.99	26.91
Fallow Area	50.07	16.04
Barren Area	71.28	22.84
Built-Up	68.01	21.79
Total Area (Ha)	**312.06**	**100**

Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

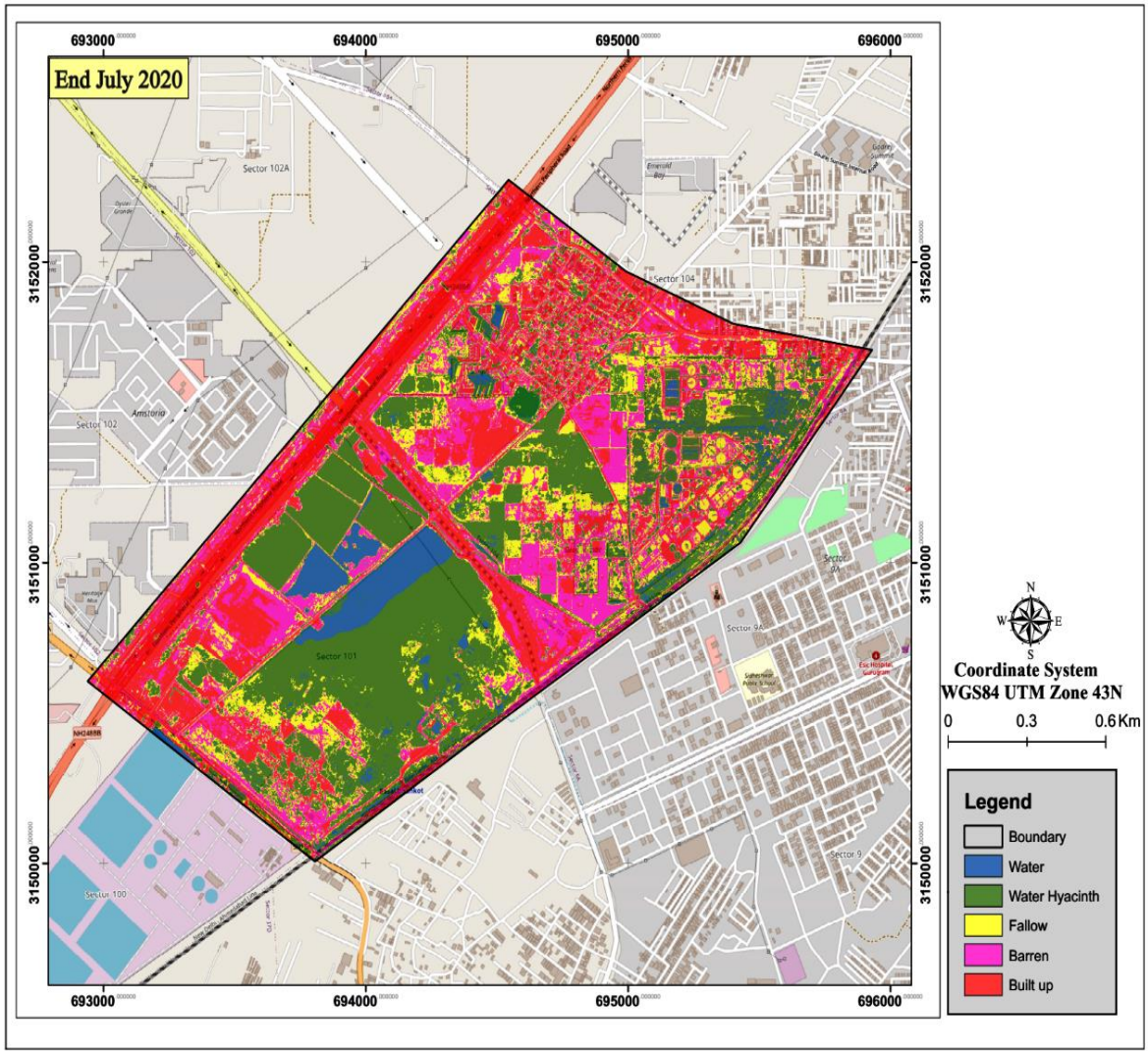
Figure 4.10 Distribution of LU/LC of Basai wetland (2018)



Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

Fig 4.10 depicts the LU/LC distribution of Basai wetland for the year 2018 mid of July. The data reveals that the maximum area under the wetland was covered with the growth of water hyacinth which accounted for more than two-fourth of the total area (26.91 per cent). More 2.84 percentage points than one-fifth of the total area (22.84 per cent) were covered with the barren area. 1.79 percentage points more than one-fifth of the total area was covered with the built-up area with 21.79 per cent. Nearly one-sixth of the total area of the wetland accounted for the fallow area which accounted for 16.04 per cent. The water area covered the minimum portion of the total area of the wetland which accounted for a meagre 12.40 per cent implying that the entire wetland was an open area.

Figure 4.11 The land use land cover classification map of Basai wetland in 2020



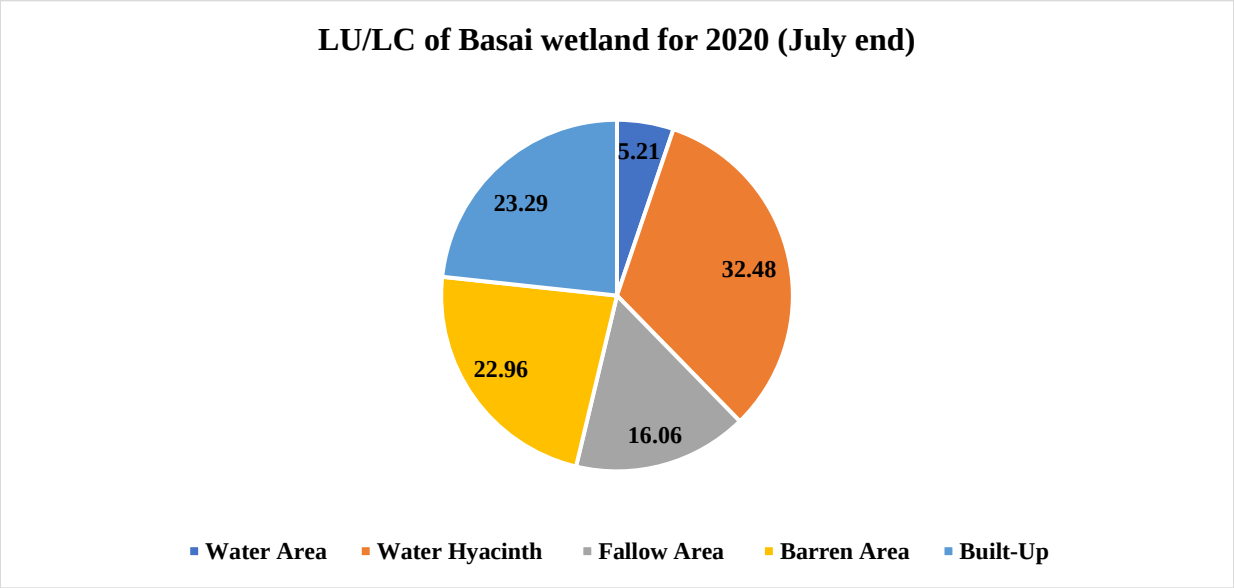
Source: Digitised in Arc GIS 10.4 software.

Table 4.6 LU/LC of Basai wetland for 2020 (July end)

	Frequency	**Per cent**
Water Area	16.25	5.20
Water Hyacinth	101.35	32.47
Fallow Area	50.11	16.05
Barren Area	71.66	22.96
Built-Up	72.69	23.29
Total Area (Ha)	**312.06**	**100**

Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

Figure 4.12 Distribution of LU/LC of Basai wetland (2020)



Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

Fig 4.12 depicts the LU/LC distribution of Basai wetland for the year 2020 end of July. The data reveals that the maximum area under the wetland was covered with the growth of water hyacinth which accounted for more than one-third of the total area (32.48 per cent). 3.29 percentage points more than one-fifth of the total area was covered with the built-up area with 23.29 per cent. 2.96 percentage points more than one-fifth of the total area was covered with barren land. The water area covered the minimum portion of the total area of the wetland which accounted for a meagre 5.21 per cent implying that the growth of water hyacinth affects the water area.

Table 4.7 Land Use Land Cover change of Basai Wetland from 2010-2020

Year	Water Area	Water Hyacinth	Fallow Area	Barren Area	Built-Up	Total Area (Ha)
2010 (End July)	28.62	89.49	38.61	142.01	13.33	312.06
2012 (Mid July)	23.28	55.35	95.49	97.04	40.9	312.06
2014 (Mid July)	31.95	66.79	88.41	74.88	50.03	312.06
2016 (Mid July)	22.21	78.65	90.19	58.16	62.85	312.06
2018 (Mid July)	38.71	83.99	50.07	71.28	68.01	312.06
2020 (End July)	16.25	101.35	50.11	71.66	72.69	312.06

Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4.

Table 4.8 Rainfall trend of Gurugram from 2010 to 2020 (millimetres)

Rainfall/mm	Jul-10	Jul-12	Jul-14	Jul-16	Jul-18	Jul-20
Gurugram	380.8	87	103.5	161	138.4	167.6

Source: Statistical Abstract of Haryana 2009-10 to 2019-20.

Table 4.8 depicts the rainfall data of Gurugram city for a period of ten years alternatively from 2010 to 2020 for July. The data shows that from July 2010 to July 2012 the rainfall was declined by 293.8 mm and after that, it was increased by only 16.5 mm in the year 2014. From July 2014 to July 2016 the rainfall was again increased by 57.5 mm but after that, it was decreased by 22.6 mm in the year 2018. 29.2 mm of rainfall was increased from 2018 to 2020 but if we talked about the decadal data i.e., from 2010 to 202, the rainfall was decreased by approx. 55 per cent which is a serious threat for the city as most of the population was involved in the agriculture sector (Statistical Abstract of Haryana, 2009-2020).

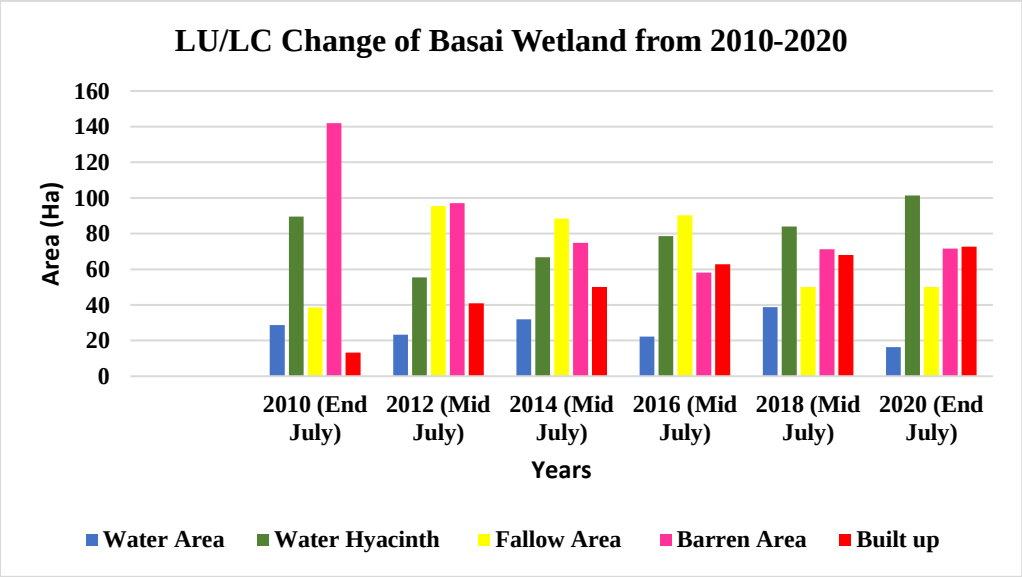
4.4.1 Classification of Basai LU/LC Maps

LU/LC is used to check the overall temporal change in the land area concerning the different variables like forest cover, vegetation, water area, urbanisation etc. In this thesis, 5 variables have been taken to know the temporal change of the Basai wetland.

The change detection of the Land use and the Land cover is depicted in (Figure 4.13) and the area of each category that is changed within 10 years alternatively are represented in Table no 4.1. The classification based on maximum likelihood shows 5 different groupings of Land use and Land cover that has been changed. They are as follows:

1. Water Area
2. Water Hyacinth
3. Fallow Area
4. Barren Area
5. Built-Up

Figure 4.13 Graph showing temporal LU/LC change of Basai wetland.



Source: Data extracted from GeoEye-1 Satellite and analysed in Arc GIS 10.4**.**

1. **Water Area:** Table 4.7 reveals that the water area had greatly fluctuated during 2010-2020. The water area was 28.62 hectares in 2010 (End of July) which was reduced by 12.37 hectares by end of July 2020 to measure only 16.25 hectares. However, this decrease had not been steady but had alternately increased during the selected years. The water area recorded a decrease in 2012, 2016 and 2020 while it had increased during 2014 and 2018. The maximum decrease in the water area was observed during 2018-2020 where the reduction was as great as 22.46 hectares while the maximum increase was seen during 2016-2018 when the water area increased by 16.50 hectares (Table 4.7, Fig 4.13) The maximum water area was witnessed in 2018 where it had covered 12 per cent (38.71 hectares) of the total area of the wetland. On the other hand, water area was minimum in 2020, covering up only 5.2 per cent of the total area of the wetland which was less than half of that recorded in the previous assessment year. The decrease in the water bodies is mainly because of two reasons. First of the reason is the declining trend of rainfall patterns in the monsoon which is almost half from 2010 to 2020. The slight increase in the year 2014 and 2018 is because of the increase in the amount of rainfall (Statistical Abstract of Haryana from 2009-10 to 2019-20). The second reason is the 13.25% increase in the growth of water hyacinth as it absorbs water.

2. **Water Hyacinth:** Table 4.7 reveals that the water hyacinth area had significantly fluctuated during 2010-2020. The water hyacinth area was 89.49 hectares in 2010 (End of July) which

was increased by 11.86 hectares by end of July 2020 to measure 101.35 hectares. However, this increase had not been steady but had decreased after 2010 and after 2012 it started increasing rapidly. The water hyacinth area recorded an increase in 2014, 2016, 2018 and 2020 while it had a decrease during 2012. The maximum increase in the water hyacinth area was observed during 2018-2020 where the total area put up as great as 17.36 hectares while the maximum decrease was seen during 2010-2012 when the water area decreased by 34.14 hectares (Table 4.6, Fig 4.13). The maximum water hyacinth area was witnessed in 2020 where it had covered 32.4 per cent (101.35 hectares) of the total area of the wetland. On the other hand, the water hyacinth area was minimum in 2012, covering up only 17.7 per cent of the total area of the wetland. The high growth of Water hyacinth absorbs more water and decrease the oxygen level in the water. It also acts as a barrier for the aquatic plants and animals as it won't allow the Sunlight to penetrate deep into the wetland (Jamil).

Image 4.2 Water Hyacinth in Basai Wetland

Source: Captured during field survey. (January 12, 2019)

3. **Fallow Area:** Table 4.1 tells that the fallow area had greatly fluctuated during 2010-2020. The fallow area was 38.61 hectares in 2010 (End of July) which rose by 11.5 hectares by end of July 2020 to measure 50.11 hectares. However, this increase had not been steady but had alternately increased during the selected years. The fallow area recorded a decrease in 2014, and 2018 while it had increased during 2012, 2016 and 2020. The maximum decrease in the fallow area was observed during 2016-2018 where the reduction was as great as 40.12 hectares while the maximum increase was seen during 2010-2012 when the fallow area

increased by 56.88 hectares (Table 4.7, Fig 4.13). The maximum fallow area was witnessed in 2012 where it had covered 30.5 per cent (95.49 hectares) of the total area of the wetland. On the other hand, the fallow area was minimum in 2010, covering up only 12.37 per cent of the total area of the wetland which was recorded at the starting of the assessment year. This is somehow because of the change in land use pattern which is the conversion of barren land into fallow land by the locals as discussed during the Field survey.

4. **Barren Area:** Table 4.7 reveals that the barren area had greatly fluctuated during 2010-2020. The barren area was 142.01 hectares in 2010 (End of July) which was reduced by 70.35 hectares by end of July 2020 to measure only 71.66 hectares. However, this decrease had not been steady but had alternately increased during the selected years. The barren area recorded a decrease in 2012, 2014 and 2016 while it had increased during 2018 and 2020. The maximum decrease in the barren area was observed during 2010-2012 where the reduction was as great as 44.46 hectares while the maximum increase was seen during 2016-2018 when the barren area increased by 13.12 hectares (Table 4.7, Fig 4.13). The maximum barren area was witnessed in 2010 where it had covered 45.5 per cent (38.71 hectares) of the total area of the wetland. On the other hand, the barren area was minimum in 2016, covering up only 18.6 per cent of the total area of the wetland. Most of the barren areas were converted to Built-up areas and the rest was converted to a small park or garden area, as discussed with the residents during the field survey.
5. **Built-Up:** Table 4.7 shows that the built-up area had greatly increased during 2010-2020. The built-up area was 13.33 hectares in 2010 (End of July) which increased by 59.36 hectares by end of July 2020 to measure only 72.69 hectares. However, this increase had been steady during the selected years. The built-up area recorded an increase in 2012, 2014, 2016. 2018 and 2020 while it had not decreased during any year. The maximum increase in the built-up was seen during 2010-2012 when the built-up area increased by 27.57 hectares (Table 4.7, Fig 4.13). The maximum built-up area was witnessed in 2020 where it had covered 23.2 per cent (38.71 hectares) of the total area of the wetland. On the other hand, the built-up area was minimum in 2010, covering up only 4.2 per cent of the total area of the wetland. The data shows that the Built-up area was increased by 445% which is a very huge change. The main reason for this big change was the 2nd Gurugram-Manesar master plan (Chopra & et, al, 2012). Gurugram also comes under the Delhi NCR region because this urbanisation was going on at a huge rate and Basai wetland was declining day by day.

4.5 SUMMARY AND CONCLUSION

Wetlands are the most important natural resource to combat climate change by absorbing twice carbon content from the atmosphere as compared to the tropical forests but due to frequent anthropogenic activities like illegal encroachment, garbage deposition, pouring of wastewater from the household are deteriorating these wetlands day by day. Basai is an urban wetland in the periphery of Gurugram city which acts as the main source of carbon sinks. Basai wetland is flanked by Dhanwapur village and Basai village. The total area of this wetland was squeezed by the encroachment and now it only remains to approx. 312 hectares.

Numerous studies had shown that LU/LC change is experienced in the country for the last 20 years as rapid urbanisation is taking place without considering the impact on the environment. This study mainly focuses on the Basai wetland in the city of Gurugram. The unique biodiversity of the Basai wetland is degraded day by day which causes a serious threat to the ecosystem. The rapid urbanisation in the city of Gurugram is the cause for completely neglecting the wetlands. If the wetlands of Gurugram is properly managed and conserved then it will be having the potential to solve the problem of water supply and water flooding during the monsoon. These wetlands also help to maintain the level of groundwater by recharging the aquifers.

This research shows the land use land cover change in the Basai wetland and provides the data to analyse the result from 2010 to 2020 alternatively. The satellite images from Geo Eye (commercial satellite) were taken and digitised by using the Arc GIS software to know the LULC change over ten years.

This study shows that over the last 10 years (i.e., from 2010 to 2020) major LU/LC changes were recorded in the Basai Wetland. The main reason which was analysed during this study shows that the built-up area was approximately increased by 445% from 2010 to 2020 and this is a serious cause for the depletion of the Basai wetland area. The water bodies of the wetland show a decline of 12.22% with many other factors which are responsible for the deterioration for example 13.25% increased growth of water hyacinth, 30% increase in the fallow land and the development of roads under the 2nd Gurugram-Manesar master plan.

The data from this chapter shows a red alert for the Basai wetland. If the rate of degradation of this wetland will continue then the wetland will be extinct soon and it will cause a serious health issue for the people of Gurugram. The pollution level of the Gurugram ranged from 250-400 AQI during winters and the main cause was stubble burning. Saving Basai wetland from its extinction will give the long-term benefit not even the people of Gurugram but also to the people of Delhi NCR.

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CHAPTER 5

BASAI WETLAND: IMPORTANCE AND CONSERVATION

5.1 INTRODUCTION

Wetlands are the most important and unique features of nature, offering a wide range of functions, serving as a source of drinking water, erosion control, plant cultivation, flood protection, climate stabilizers, groundwater recharge, purification and detoxification of water (Solanki & Joshi, 2017). Local communities benefit greatly from wetlands, as they are an important source of food and water for wildlife and indigenous fauna, especially during the dry season and drought. The wetlands also provide food, firewood and construction wood, raw materials for the furniture industry, medicine and feed for rural communities. Wetlands increase the income of rural households, especially women. Therefore, wetlands contribute greatly to poverty alleviation and food self-sufficiency efforts. (Amsalu & Addisu, 2014).

A large number of terrestrial and aquatic flora and fauna have their niche in the wetlands. Chapter 1st gives many definitions of wetland from different countries and many organisations but the definitions given by Ramsar Convention on wetland is the most chosen one for the research work. Article 1 of Ramsar convention states that "area of marsh, fen, peatland or water, whether natural or artificial permanent or temporary, with water that is static or flowing, fresh brackish or salt, including areas of marine water the depth of which at low tides does not exceed six meters" (Ramsar 1971). Despite these wetlands throughout the world are flanked by many anthropogenic activities like illegal encroachments, toxic waste from the industries, unawareness of the people living adjacent to the wetland about the benefits of the wetland also speed up the degradation of wetlands.

The urban wetlands are the most vulnerable ones as they are facing the conversion of their area to landfills, putting of industrial waste which increases the pollution level in the wetland. Overuse of the wetlands by the excess withdrawal of water as compared to inflow creates the alert for these hydrological resources. So, the biodiversity of these wetlands is badly affected sideways decreasing the supply of goods and services by the wetlands (Ramachandra, 2009, Ramachandra et.al., 2012).

The degradation of wetlands water quality, which has negative economic, environmental, and social, effects in India, is a major source of worry.

This issue is particularly more disturbing exclusively for small water bodies like small lakes, ponds, ditches and tanks. These small water bodies had performed many functions in the earlier times like

social (drinking water), economic (cattle, fish, forest wood), and ecological (biodiversity conservation, aquifers recharge, nutrients). Despite all these social, economic and ecological benefits, wetlands are terms as 'wasteland' by various decision-makers and even by many people who are living adjacent to wetlands areas after taking the use of these wetland goods and services and rarely agree to pay for these resources (Verma, 2001).

The main problems for the wetlands are from Human-induced like illegal encroachment by the locals and industries for their benefit. This lack of interest from the local public creates an alarm for the wetlands as they are facing an extinction threat today. This chapter is based on one such wetland namely the Basai wetland in Gurugram district of Haryana state, India. Basai wetland is also facing a lack of interest by the local governing body and adjacent people due to unawareness of the services and goods of this wetland and shrinking rapidly over the recent years. The speed of the encroachment by the expansion of the city and industries is a major point of concern.

This research focuses on the current situation of the Basai wetland and compares it to Sultanpur National Park, which is located close by yet receives top environmental care and status. The main objectives of this chapter: -

I. The ecological and environmental importance of Basai wetland.
II. To explore the comprehensive comparison between Basai wetland and Sultanpur wetland.
III. To examine the threats and challenges being faced by the Basai wetland and the role of local government.
IV. To find out the conservative measure for the protection of the wetlands.

Basai wetland is situated between the Basai village and Dhanwapur village of sectors 101 and 9B in Gurugram district of Haryana state and 8 km away from Sultanpur National Park. The total area of the wetland is about 312.06 hectares calculated by satellite images containing Water Hyacinth, Typha reed beds. The water in the Basai wetland comes from a breached water channel which brings sewage treatment water from the wastewater treatment plant. During the monsoon season, the water area of the wetland increases up to 50 hectares due to the accumulation of rainwater. The wetland is a place for livestock and birds to roam and consume wild vegetation like Bar-headed Geese Anser indicus which flock here during winters. Basai wetland and Sultanpur wetland both come under Important Bird Areas (IBAs) of Haryana recognised by the Bombay Natural History Society (BNHS).

5.2 DATA SOURCE AND METHODOLOGY

The source of data for this chapter was mainly taken from secondary sources like newspapers, government websites, national and international organisations and published research papers etc. The data for all these sources have been investigated and analysed to fulfil the above objectives.

5.3 BASAI WETLAND: FEATURES AND IMPORTANCE

Nearly 243 different species of avifauna have been recorded since February 2001 in the Basai wetland shows that this place is a bird paradise. In September 2001 BNHS established a bird ringing camp for five days and recorded 154 species of birds in the Basai wetland (International, 2021). Various threatened avifauna species such as Marbled Duck, Sarus Crane, Lesser Spotted Eagle, Greater Spotted Eagle, Lesser Kestrel Falco and Imperial Eagle had recorded here with numerous near-threatened species such as Black-necked Stork, Painted Stork, Oriental White Ibis, or Black-headed Ibis, Asian Dowitcher and Pallid Harrier. During winter the total number of Bar-headed Goose had touched up to 1100 however, 18 different species of Duck's number had touched up to 5000, and 36 different species of Waders number reached 10000. Indian Bird Conservation Network stated that the total number of avifauna species witnessed in Basai far exceeds the 1 per cent biogeographic threshold limit projected by the Wetlands International organisation in 2002. According to the 1 per cent biogeographic threshold limit, the number of Bar-headed Goose is 560, but Basai has witnessed about twice that number i.e., 1100 (IBCN, 2015). The senior-most forest conservator M.D. Sinha (south circle) of Gurugram district said that the wetlands which are nearby the Gurugram city border play a vital role in stabilising the hydrological balance in the city. The salinity of the Basai wetland shows great importance as it requires for the bio-filtration of groundwater. Also, the presence of these wetlands in the city helps to maintain the ecological balance of the region because it is the place for many animals, birds and insets (Arora, S, 2016).

Birders, naturalists and nature sweethearts give a successive visit to Basai wetland to appreciate in the lap of nature. This wetland close to Sultanpur Bird Sanctuary is likely perhaps the most regularly visited wetlands of Delhi-NCR birder. Obscure to the end of the week excursion sightseers who normally head for Sultanpur Bird Sanctuary, Basai gives an incredible chance to watch different types of birds from an extremely close distance (Phukon, 2020). In fact, in the heart of the city, surrounded by skyscraper concrete jungles, the Basai Bird Reserve is one of Delhi's most controversial birdwatching destinations that needs public help for its protection (Upreti, 2016).

The Basai wetland is a verification that even treated sewage water can be the home of thousands of birds if appropriately ensured and kept up with. This reality holds extraordinary significance, particularly on present occasions, when the vast majority of the normal shallow wetlands have been changed over into rural fields by emptying water or contamination in the Indo-Gangetic fields. Thus, there is a need to make more wetlands alongside saving and re-establishing the regular ones. (IBCN, 2015).

5.4 BASAI AND SULTANPUR BIRD AREAS: A COMPARISON

The capability of Sultanpur was first perceived at the Conference of the International Union for Conservation of Nature (IUCN) held in New Delhi in 1969 which brought about a proclamation of an area of 1.21 sq. Km. as a Sanctuary under section 8 of the Punjab Wildlife Preservation Act, 1959 which was additionally moved up to National Park under Section 35 of the Wildlife (Protection) Act, 1972. After that an area of 0.21 sq. Km was further added and also given the new designation of National Park with a combined area of 1.42 sq. Km. The Sultanpur National Park includes the land taken out from Sultanpur, Sadhrana, Chandu, and Saidpur towns (Haryana Forest Department). Then again, Basai wetland, even though, goes under the ward of Sultanpur Bird Sanctuary however has not been allowed any preservation status at this point. The central government of India and Bombay Natural History Society recognize Basai wetland Under Important Bird Areas (IBAs) but the state government of Haryana is not even giving it a wetland status.

Table 5.1 Important Bird Areas of Haryana

A1= Threatened species; A2 = Restricted Range species; A3= Biome species; A4=Congregatory species

IBAs of Haryana

IBA site codes	IBA site names	IBA criteria
IN-HR-01	Basai Wetlands	A1, A4i, A4iii
IN-HR-02	Bhindawas Wildlife Sanctuary	A1, A4i, A4iii
IN-HR-03	Kalesar Wildlife Sanctuary	A1, A3
IN-HR-04	Sultanpur National Park	A1, A4i, A4iii
IN-HR-05	Wetlands of Yamuna River	A4iii

Source: ibcn.in/wp-content/uploads/2015/05/Haryana.pdf

As indicated by Indian Bird Conservation Network (IBCN) information (Table 5.1), shows that Basai wetland, Sultanpur and Bhindawas wetlands meet similar IBA models of A1, A4i and A4iii. Strangely, Sultanpur and Bhindawas have been allowed the recognition of National Park and Wildlife

Sanctuary, individually whereas, Basai wetland doesn't even fall under any preservation scheme. A nearer examination between Sultanpur National Park and Basai wetland doesn't uncover a lot of distinction between them. (Table 5.2).

Table 5.2: Broad Comparison between Basai Wetland and Sultanpur Bird Sanctuary

Category	Basai Wetland	Sultanpur Wetland
IBA Site code	IN-HR-01	IN-HR-04
Area	100 ha	143 ha
Coordinates	28° 28' 60"N, 76° 58' 60"E	28° 28' 00"N 76° 55' 00E
Total Bird Species	243	258
Critically Endangered (CR)	2	5
Endangered (E)	3	4
Vulnerable (VU)	7	10
Near-Threatened (NT)	17	20

Source: ibcn.in/wp-content/uploads/2015/05/Haryana.pdf.

Table 5.2 depicts the broad comparison of Basai and Sultanpur wetlands with different criteria. The IBAs site code for Basai wetland is IN-HR-01 and for Sultanpur wetland is IN-HR-04 which shows that initially Basai wetland was granted the IBAs status. The area difference between Basai wetland and Sultanpur wetland was only 43 hectares in which Sultanpur wetland was having more area and the distance between both the wetlands was 8 Kms only. The difference between total bird species was 15 in which Sultanpur National Park has on the higher side. The comparative difference between critically endangered (CR), Endangered (E), and Vulnerable (VU) was 3, 1 and 3 respectively and for Near Threatened (NT) the difference was 3. For all the species Sultanpur National Park is again on the higher side. This shows that Sultanpur National Park was having more bird species than Basai Wetland but the difference is not that much so we can say that Basai wetland is also a bird paradise and the state government should focus on this wetland.

Table 5.3: Bird Species Specification under IUCN Red-List in Basai Wetland

Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Near-Threatened (NT)
White-rumped Vulture	Egyptian Vulture	Great Spotted Eagle	Alexandrine parakeet
Red-headed Vulture	Steppe eagle	Eastern Imperial Eagle	Asian dowitcher
-	Black-bellied tern	Indian spotted Eagle	Black-headed ibis
-	-	Sarus Crane	Black-necked stork
-	-	Marbled Teal	Black-tailed godwit
-	-	Common Pochard	Curlew sandpiper
-	-	Woolly-necked stork	Eurasian curlew
-	-	-	European roller
-	-	-	Ferruginous duck
-	-	-	Lesser flamingo
-	-	-	Northern lapwing
-	-	-	Oriental darter
-	-	-	Painted stork
-	-	-	Pallid harrier
-	-	-	Red-necked falcon
-	-	-	River lapwing
-	-	-	River tern

Source: http://avibase.bsc-eoc.org/checklist.jsp?region=INnwhr01&list=howardmoore.

Table 5.4: Sultanpur Wetland: Bird Species Specification under IUCN Red-List in Basai Wetland.

Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Near-Threatened (NT)
Indian Vulture	Black-bellied tern	Common Pochard	Alexandrine parakeet
Red-headed Vulture	Egyptian Vulture	Dalmatian Pelican	Black-headed ibis
Sociable Lapwing	Saker Falcon	Eastern Imperial Eagle	Black-necked stork
White-bellied Heron	Steppe eagle	Finn's Weaver	Black-tailed godwit
White-rumped Vulture	-	Great Spotted Eagle	Curlew sandpiper
-	-	Indian spotted Eagle	Eurasian curlew
-	-	Lesser Adjutant	Falcated Duck
-	-	Lesser White-fronted Goose	Ferruginous Duck
-	-	Sarus Crane	Great Thick-knee
-	-	Stoliczka's Bush Chat	Grey-headed Fish Eagle
-	-	-	Laggar Falcon
-	-	-	Lesser flamingo
-	-	-	Northern lapwing
-	-	-	Oriental Darter
-	-	-	Painted stork
-	-	-	Pallid Harrier
-	-	-	Red-necked falcon
-	-	-	River lapwing
-	-	-	River tern
-	-	-	Spot-billed Pelican

Source: http://haryanaforest.gov.in/SultanpurNationalPark.aspx.

Table 5.3 and Table 5.4 depicts the comparative analysis between Basai Wetland and Sultanpur National Park of bird's species based on the IUCN red list. Redheaded Vulture and White-Rumped Vulture were common in critically endangered (CR) criterion for Basai wetland and Sultanpur National Park but Indian Vulture, Sociable Lapwing, White-bellied Heron species of bird only found in Sultanpur National Park. Saker Falcon is the only endangered (E) species found in Sultanpur National Park other three species Black-bellied tern, Egyptian Vulture and Steppe Eagle were found in both the places i.e., Basai wetland and Sultanpur National Park. Marbled Teal and Woolly-necked Stork are the vulnerable species found in Basai Wetland only and five species i.e., Great Spotted

Eagle, Eastern Imperial Eagle, Indian spotted Eagle, Sarus Crane, Common Pochard were found in Basai wetland and Sultanpur National Park both (Table 5.3 & 5.4). For the last criterion, the near-threatened Basai wetland was having 17 species and Sultanpur National Park was having 20 species with a total of 15 species in common. Asian dowitcher and European roller are the only near-threatened species found in the Basai wetland only. Falcated Duck, Great thick-knee, Grey-headed fish eagle, Lagger falcon and Spot-billed pelican come under near-threatened species found in Sultanpur National Park only.

Haryana Government has not recognised Basai as a wetland in any event, when it has almost similar criteria and numbers of bird species as Sultanpur National Park. The state government is not concerned about the Basai wetland since it is situated between two settlements of the HSVP province in Gurugram i.e., sector 101 and area 9B. In addition, various development projects are coming up nearby the wetland and the development of the Dwarka freeway are additionally in progress.

Image 5.1 Great Egret bird in Basai wetland

Source: Captured during field survey. (January 12, 2019)

Image 5.2 Grey-headed Fish Eagle in Basai wetland

Source: Captured during field survey. (16 march 2019)

5.5 BASAI WETLAND: THREATS AND CHALLENGES

The Basai wetland is a bird paradise and because of negligence and unsustainable development use, this place become the best example of environmental destruction and a threat to the plant and animal habitat.

The total number of birds species were spotted in the Basai wetland in the year 2015 was 320, however, this number was decreased to 240 in the year 2016 as per the data provided by the wildlife department (Pati, 2016). Asian dowitcher and European roller and Red-headed Vulture are among the 240 species seen in the area. The state bird of Haryana Black francolin and flamingos were the most common birds found in Basai wetland once. The numbers of these birds are now decreasing day by day (Dhankhar, 2017). Individuals who know about this reality are quite worried about the declining bird's species here and show their profound distress to the way that this wetland, which was prior a bird's heaven and a major wellspring of groundwater re-energize, presently has limited to simply a patch of marshy land having only one sq. Km. of the region.

Gurugram is one of the greatest industrial centres in the Delhi NCR area and is likewise well known for the DLF digital city. Haryana government is selling plots here consistently which is a genuine

danger encompassing the climate and in the wake of presenting the second Gurugram-Manesar master plan, the advancement level has additionally ascended which is going about as a termite for Basai Wetland as it is destroying the wetland via encroachments.

Basai had been disregarded however Sultanpur adores in the maintenance and conservation status because of its control by the forest department since the 1950s. Further, Basai's rich biodiversity had confronted annihilation because of the huge scope of urbanization after the presentation of the second Gurugram-Manesar Master Plan, and presently is confronting the danger of vanishing. (Chopra & et, al, 2012)

The underground water table is crucial to guarantee sufficient water supplies for the inhabitants of a city and a wetland is the significant wellspring of groundwater re-energize and keeping up with the hydrological balance. Thinking about this component, the Basai wetland is vital to a city like Gurugram which countenances regular flooding and resultant traffic disarray pretty much every rainstorm season. Such open spaces give alleviation from waterlogging in these " concrete jungles ". The significance of these wetlands in an over-populated city like Gurugram has likewise been recognized by Mr G.S. Bal, who is a specialist in disaster management from Amity University. The consistently expanding population and development of elevated structures/skyscrapers in the city are unfavourably influencing its underground water table. In such a situation these wetland plays many important functions like recharging groundwater by absorbing the rain and otherwise such a metropolitan city will be affected by urban floods, as was observed in the case of Chennai, Tamil Nadu. (Arora, S, 2016)

The order was given by the National Green Tribunal (NGT) directed all state governments to confirm sustainable use of natural wetlands and preserve their existence (Pati, 2016). C&D (Construction and Demolition) waste plant was inaugurated by the Chief Minister of Haryana on 16th June 2017 on an area of 3.5 acres of Basai wetland, which was suggested by the Municipal Corporation of Gurugram (MCG). This C &D plant was about to treat nearly 500 tonnes of wastage every day and it was started in the starting month of 2018.

Image 5.3 Construction & Demolition Waste Recycling Plant

Source: Captured during field survey. (28th Jan 2021)

'Delhi Bird Foundation" an NGO from Delhi filed a complaint in the National Green Tribunal on June 22nd, 2017 against the Haryana State Government for approving the construction of C & D plant at the periphery of Basai wetland and not designation it as a 'Wetland'.

As expressed in the appeal, as per the C&D the board management rules 2016, a waste management plant can't be built along a wetland, national park, forest, water body or human settlement, and complaint also stated that Basai has not been designated as a wetland under the (Wetland and Management) Rules 2017 regardless of having a rich avifauna and amphibian life. Responding to this, the Union Ministry of Environment, Forest and Climate Change (MoEF &CC) strongly asking answers from the Haryana government for not giving any notification to recognize and designate Basai as a wetland.

On 12th August 2017, 6 pictures showed to National Green Tribunal by Delhi based NGO, the Delhi Bird Foundation in which the total area of 900 acres of Basai wetland was presented and requested to stop the construction of C & D plant nearby Basai Wetland. These photographs were taken from

Google images about one to two years back. The NGO said that Basai was a bird paradise and had a huge aquatic ecosystem (Arora, S, 2017).

The stopping of the breach in the water channel and extension of the housing project by Haryana Shahari Vikas Pradhikaran (HSVP) west of the railways can pose a serious threat to the Basai wetland. Moreover, there is a problem of shooting and trapping birds at night during winters (IBCN, 2015).

5.6 SUMMARY AND CONCLUSION

Wetlands, one of the most productive and efficient ecosystems in the world, are critically endangered and the Basai Wetlands is one of them. The Bombay Natural History Society has reported Basai as an Important Bird Area (IBA) serving some 243 different species of birds, including the Black Francolin state bird, while the Haryana government has not granted any status. this wetland. Basai Wetland, which sits in the middle of HSVP Sectors 101 and 102, can help prevent waterlogging in the city during heavy rains, as wetlands are the best source of groundwater recharge, as well as helping to agriculture and the provision of habitat for birds and aquatic organisms' life, even in sewage-treated water. The state government sold the land under the Basai wetland as urbanization and industrialization increased, causing its area to shrink rapidly. It appears that the Basai wetland has become entangled between real estate and infrastructure projects that are again being developed at the expense of the environment (Solanki & Joshi, 2017).

5.7 WETLANDS AND SOCIAL COST OF CARBON

Wetland generates the economy, as discussed in the previous chapters. Every country's development was based on their economy so, we can say that wetlands are directly responsible for the country's economic growth. The word social cost of carbon is also related to the wetland. The social cost of carbon in India is 86$ per tonne of carbon which is equal to approx. Rs 6400.

The Social Cost of carbon (SCC) is used to evaluate in USD (Dollar), all monetary damage that would happen by emitting 1 ton of CO_2 into the atmosphere. It indicates how much it is worth to us today to avoid the damage that is predictable for the coming future. Wetland sequesters CO_2 from the atmosphere and acts as carbon sinks utilizing mangroves, salt marshes and aquatic plants. So, the increased number of wetlands in the country will help in decreasing the Social Cost of carbon for the country.

5.8 CONSERVATIVE MEASURE TO PROTECT WETLANDS

5.8.1 "Wetcide" The Solution for Protection "The Future Research".

On 26th October 2021, the general secretary of the United Nations (UN) said to the press that if we will continue with the same track then the global temperature rise will be 2.7 degrees for the next century which is far more than the Paris agreement target of maintaining the 1.5 degrees. This statement has come just ahead of the COP 26 (Conference of Parties) Glasgow conference. Climate change is a major concern for the whole world majorly for the low-lying countries like Maldives, Seychelles, Mauritius etc and for maintaining the global temperature rise wetlands plays an important role because wetlands are the good source for absorbing the atmospheric carbon by the process called carbon sequestration (United Nations, 2021).

In today's world, wetland crimes are emerging day by day and the concern is serious now which is drastically affecting the existence of humanity. The legality of these wetland crimes should fit in the International Law and has to be investigated so that people start thinking twice before committing these crimes. Written wetland law should introduce in the International Criminal Court (ICC) with proper format and a committee will be introduced for the proper punishment and amount for those who will commit this crime.

During this research, a new word was introduced **"Wetcide"** which is an acronym for "wetland suicide". The meaning of suicide is the act of killing oneself. The meaning of the word **"Wetcide"** is the deterioration of wetland by self? (Not possible), Let it be explained in detail. Wetlands are a natural resource that is necessary for the existence of life on earth. Wetlands act as the transition zone between terrestrial life and aquatic life. They are also called the lungs of the earth. No natural resource destroy itself. All-natural resources are directly or indirectly deteriorating by the effect of Human activities even after they are the most important part of the existence of life on earth. We can say that natural resources or wetlands are part of Human life so **"Wetcide"** is the killing of wetlands directly or indirectly by Humans. The word **"WetCide"** is taken by the similar kind of word Ecocide (Gauger & et, al, 2012) which is already in the process of making law in the International Criminal Court (ICC) Rome Statue. There is no official legal definition of the term **"Wetcide"** as the word is not coined by anyone earlier**.** This thesis provides the definition of the term **"Wetcide"** which is that **"The illegal encroachment of wetland, throwing of garbage and foolish use of wetland".**

Image 5.4 Garbage in the Basai Wetland

Source: Captured during field survey. (28th June 2021)

Image 5.5 Destruction of Basai Wetland by anthropogenic activities

Source: Captured during field survey. (28th June 2021)

SUMMARY AND CONCLUSION

From 31st October to 12th of November, 2021 COP26 was held at Glasgow, Scotland hosted by the United Kingdom in collaboration with Italy which had to be held in 2020 but due to COVID-19, it was postponed. The major point of concern and discussion was global warming along with controlling the carbon emission for which member countries pledged to achieve the net-zero aim (COP26, 2021).

Carbon emissions from developed and developing countries are the major source of the global temperature rise. The net-zero term was introduced which means balancing the emission of carbon by the absorption of carbon. Increasing the carbon sinks or carbon sequestration is the main thing every nation need to focus on. For controlling the emission of carbon, wetlands play the most important role because of their carbon-absorbing capacity.

Wetlands are an important part of the ecosystem and a dominant natural resource that can be conserved and maintained for the existence of humans. There is much international organisation (Ramsar, What are wetlands?, 1971) and government rules (Ministry Of Environment, 2017) that are functional for the protection and conservation of wetlands. Still, the condition of the wetlands is deteriorating, so many valuation techniques were innovated by many environmentalists to give monetary benefit for the wetland goods and services. These valuation techniques were works according to the direct or indirect benefit of the wetland goods and services. The contingent valuation method was one of the valuation techniques for valuing the wetlands.

The contingent valuation method is the direct valuation of ecosystem services. The Contingent valuation method is based on people's willingness to pay for the ecosystem services and it will show the economic value of the ecosystem. For this research, the ecosystem service is the Basai wetland. For knowing the Contingent valuation method structured questionnaire was framed and 250 face-to-face Schedule method was done in two villages adjacent to the Basai wetland.

The major objective of this chapter was to analyse the direct benefit of the Basai wetland. This chapter explained the details of the contingent valuation method that was done by the primary survey. The survey questionnaire was formed to know the people's perception and their willingness to pay for the wetland services and future conservation from the residents of Dhanwapur and Basai villages located in the vicinity of this wetland. The demographic information of Dhanwapur village showed that they were more literate as compared to Basai village and were also economically better off. The result showed that the average amount for willingness to pay was Rs 832 per month which was a good

amount as compared to the amount calculated in another literature review (Abraham, 2004). The reason for this was that Basai wetland is an urban wetland and the people living adjacent to the wetland were having good per capita income. They were more concerned about the conservation and protection of the wetland as discussed during the field survey.

The contingent valuation was further used in the next chapter for knowing the total economic valuation of the Basai wetland.

The total economic value of the Basai wetland was analysed by using the (Barbier, Acreman, & Knowler, 1997) model of Use Value and Non-use Value. For use-value, Contingent Valuation Method (CVM) was used and for the Non-use Value, Hedonic Pricing Model (HPM) was used.

The CVM was used to gather the public perspective for willingness to pay for the conservation and maintenance of the ecosystem services. The structured questionnaire was framed and face to face interviews were held to know the willingness to pay from the public living near the wetland. For CVM, 250 households were selected and interviewed from Dhanwapur and Basai village and the average willingness to pay the amount calculated was Rs 832 per month.

The HPM was used to know the variation in house prices by different environmental services. The nearness to the Basai wetland resulted in more cost of the house as compared to the house that is far away from the Basai Wetland. For HPM, again 250 households were selected and respondents were interviewed from Dhanwapur and Basai village. These two villages were selected because they were adjacent to the Basai Wetland. The regression analysis was done to know the effect of distance for the Basai wetland on the house price. As expected, the distance from the Basai wetland to the house price showed a significant effect. The analysis showed that an increase of one meter away from the Basai wetland led to the fall in the house price by Rs. 645 which can be considered as a high impact. In all, we can say that the ecosystem services showed a positive impact on house price, hence asserting the fact that that it is also an important part of the city's development.

The Total Economic Value of the Basai wetland was calculated by adding the value of CVM and HPM and the value obtained was Rs. 1477 which is a very huge amount as was observed and understood from different literature reviews (Abraham, 2004) (Ramachandra, Rajinikanth, & Ranjini, 2005).

Numerous studies had shown that LULC change has been seen throughout the country (India) over the last 20 years as rapid urbanisation is taking place without considering the impact on the environment. This study mainly focuses on the Basai wetland in the city of Gurugram. The unique biodiversity of the Basai wetland is degraded day by day which causes a serious threat to the

ecosystem. The rapid urbanisation in the city of Gurugram is the reason for the complete neglect of the wetlands. If this wetland of Gurugram is properly managed and conserved, then it will be having the potential to solve the problem of water supply and water flooding during the monsoon season. The wetland also helps to maintain the level of groundwater by recharging the aquifers.

This research studied the Land Use Land Cover (LULC) changes in the Basai wetland and analysed the data obtained from satellite imageries for the period 2010-2020. This study revealed major Land Use Land Cover Changes in the Basai Wetland over the last 10 years. It was observed that the built-up area had increased by approximately 445% during this period leading to the depletion of area of the wetland. The water bodies of the wetland showed a decline of 12.22% in the total area which can be attributed to the changes in the other factors, notably, 13.25% increased growth of water hyacinth, 30% increase in the fallow land and the development of roads under the 2nd Gurugram-Manesar master plan.

In today's world, wetland crimes are emerging at a fast rate and pose a serious concern to the environment which can dramatically affect the existence of humanity. The legality of these wetland crimes should fit in the International Law and has to be investigated so that people give a serious thought before committing any of these crimes. Written wetland law should be introduced in the International Criminal Court (ICC) with proper format and a committee needs to be constituted for deciding the quantum of the punishment and/or fines against the people committing wetland crimes. During this research, a new term was introduced "**Wetcide**" which is an acronym for "wetland suicide". The literal meaning of the term suicide is the act of killing oneself. However, in the context of the natural resources including wetlands, this term refers to the act of killing or deteriorating the natural system along its resources through human activities. Humans have been making use of these resources for fulfilling their needs since the beginning and the reckless use of natural resources including wetlands has led to irreparable damage to the earth ecosystem. Hence, "**Wetcide**" is the killing of wetlands directly or indirectly by humans. The term "**Wetcide**" has been coined on the lines of the term Ecocide (Gauger & et, al, 2012) which is already in the process of law making in the International Criminal Court (ICC) Rome Statue. There is no official legal definition of the term "**Wetcide"** as the term has never been in use before**.** This thesis provides the definition of the term "**Wetcide**" which states it as **"The illegal encroachment of wetland, throwing of garbage and foolish use of wetland".**

This research has effectively assessed the total economic value of Basai wetland which is relatively unknown and to a great extent ignored wetland as compared to the other wetlands in the country where effective management and conservation measures are being implemented. The importance of Basai wetland has been clearly revealed and evaluated in this research which greatly asserts the requirement and necessity for its proper management and conservation. This thesis can become instrumental in framing appropriate policies and stricter laws for the conservation of the wetlands including Basai. Further, the term **"Wetcide"** has a great potential for future research amongst the scholars and academicians belonging to various streams and sciences such as ecology, botany, zoology, agriculture, etc.

LIMITATIONS OF THE STUDY

The study could have been more extensive by including more respondents from the selected villages along with the residents of the urban areas surrounding the wetland. However, due to the ongoing Covid-19 Pandemic, the respondents were sceptical and hesitant in participating in the survey carried on for data collection. Further, as this study explores a relatively new area of environmental research, there was a lack of awareness amongst the participants about the functions of the wetlands.

However, despite of these limitations, best efforts have been made to provide an unbiased and correct evaluation and assessment of the total economic value of Basai wetland though the scope of improvement for future studies on this topic shall always remain.

References

Badamfirooz, J., Mousazadeh, R., & Sarkheil, H. (2021, September). A proposed framework for economic valuation and assessment of damages cost to national wetlands ecosystem services using the benefit-transfer approach. *Environmental Challenges, 5*. Retrieved from https://doi.org/10.1016/j.envc.2021.100303

Burinskiene, M., Rudzkiene, V., & Venckauskaite, J. (2011). MODELS OF FACTORS INFLUENCING THE REAL ESTATE PRICE. *ENVIRONMENTAL ENGINEERING*, 873-878. Retrieved from https://www.researchgate.net/publication/266878986_Models_of_factors_influencing_the_real_estate_price

Costanza, R., & et al. (1997). The value of the world's ecosystem services and natural capital. *Nature, 387*(6630), 253–260. Retrieved from https://www.nature.com/articles/387253a0

Mozumder, C., & et.al. (2014, July 24). Ecosystem evaluation (1989–2012) of Ramsar wetland Deepor Beel using satellite-derived indices. *Environ Monit Assess*. doi:10.1007/s10661-014-3976-2

Ramachandra, T., & et, al. (2011, Jan). Ecological and socio-economic assessment of Varthur wetland, Bengaluru (India). *Journal of enviornmental science & engineering, 53*(1), 101-8. Retrieved from https://pubmed.ncbi.nlm.nih.gov/22324154/

Abraham, S. (2004). *Economic Valuation Of Coastal Wetlands: A Study Of Cochin Backwaters In Kerala.* COCHIN UNIVERSITY, FACULTY OF SOCIAL SCIENCES COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY.

Aminrad, Z., & et al. (2011). Influence of Age and Level of Education on Environmental Awareness and Attitude: Case Study on Iranian Students in Malaysian Universities. *The Social Sciences, 6*(1), 15-19. doi:10.3923/sscience.2011.15.19

Amsalu, T., & Addisu, S. (2014, September). A review of Wetland Conservation and Management Policy in Ethiopian. *International Journal of Scientific and Research Publications, 4*(9). Retrieved from http://www.ijsrp.org/research-paper-0914/ijsrp-p33114.pdf

Anonymous. (2020, dec 30). *The Ramsar Convention on Wetlands.* (A. Government, Ed.) Retrieved from environment.gov.au: https://www.environment.gov.au/water/wetlands/ramsar

Arora, S. (2016, Feburary 11). Once a 100-acre wetland, Basai is now just a patch of its former self. Retrieved from https://timesofindia.indiatimes.com/city/Gurugram/Once-a-100-acre-wetland-Basai-is-now-just-a-patch-of-its-former-self/articleshow/50941653.cms.

Arora, S. (2017, August 12). *Entire Basai is a Wetland: NGO submits photo proof to NGT*. Retrieved from The Times Of India: https://timesofindia.indiatimes.com/city/Gurugram/entire-basai-is-wetland-ngo-submits-photo-proof-to-ngt/articleshow/60027857.cms

Arya, A. K., Joshi, K. K., Bachheti, A., & Deepti. (2020). A review on distribution and importance of wetlands in the perspective of India. *Journal of Applied and Natural Science, 12*(4), 710 - 720. doi:10.31018/jans.v12i4.2412

Backman, I. (2021). *Stanford explainer: Social cost of carbon.* Stanford University. Retrieved from https://news.stanford.edu/2021/06/07/professors-explain-social-cost-carbon/

Barbier , E. (1993). Sustainable use of wetlands Valuing tropical wetland benefits: economic methodologies and applications. *The Geographical Journal, 159*(1), 22-32.

Barbier, E. B., Acreman, M., & Knowler, D. (1997). Economic valuation of wetlands: a guide for policy makers and planners. *Ramsar Convention Bureau.* Gland, Switzerland. Retrieved from https://www.researchgate.net/publication/246010067_Economic_valuation_of_wetlands_a_guide_for_policy_makers_and_planners

Bassi , N., & et al. (2014). Status of wetland in India: A review of extent, ecosystem benefits, threats and management strategies. *Journal of Hydrology: Regional Studies, 2*, 1-19.

Bennett, J., & et.al. (1998). Testing the validity of responses to contingent valuation questioning. *The Australian Journal of Agricultural and Resource Economics, 42*(2), 131-148. Retrieved from https://onlinelibrary.wiley.com/doi/pdf/10.1111/1467-8489.00041

Bhattacharyya, A., & et.al. (2008). A Critical Study on Status of East Kolkata Wetlands with Special Emphasis on Water Birds as Bio-Indicator. *Proceedings of Taal2007: The 12th World Lake Conference*, pp. 1561-1570.

Brander, L., & Schuyt, K. (2010). Benefits transfer: The economic value of world's wetlands. *The economics of ecosystem and biodiversity*. Retrieved from https://www.cbd.int/financial/values/g-value-wetlands.pdf

Cao, W., Wu, D., Huang, L., & Liu , L. (2020). Spatial and temporal variations and significance identification of ecosystem services in the Sanjiangyuan National Park, China. *Scientific Reports, 10*, 6151. doi:https://doi.org/10.1038/s41598-020-63137-x

Census. (2011). *Demography*. Retrieved june 09, 2021, from District Gurugram: https://gurugram.gov.in/about-district/demography/

Chen, C., & et.al. (2019). Knowledge-Based Identification and Damage Detection of Bridges Spanning Water via High-Spatial-Resolution Optical Remotely Sensed Imagery. *Journal of the Indian Society of Remote Sensing*. doi:doi.org/10.1007/s12524-019-01036-z(0123456789().,-volV

Chen, C., & R, R. (2010). An application of hedonic pricing analysis to the case of hotel rooms in Taipei. *Tourism Economics, 16*(3), 685–694.

Chopra, G., & et, al. (2012). Status and conservation of avian fauna of Sultanpur National Park Gurgaon,Haryana (India). *Journal of Applied and Natural Science, 4*(2), 207-213. Retrieved from https://www.researchgate.net/publication/275462263_Status_and_conservation_of_avian_fauna_of_Sultanpur_National_Park_Gurgaon_Haryana_India

Convention, R. (1971). *The Ramsar Sites Criteria.* Convention on Wetlands Ramsar, Iran. Retrieved from https://www.ramsar.org/sites/default/files/documents/library/ramsarsites_criteria_eng.pdf

Cooper, P. (2008). What can we learn from old wetlands? Lessons that have been learned and some that may have been forgotten over the past 20 years. *Science Direct. Desalination*, 11-26.

COP26. (2021, November 15). *Uniting The World To Tackle Climate Change*. Retrieved from ukcop26: https://ukcop26.org/

Cowardin, L. M., & et. al. (1992). Classification Of Wetlands And Deepwater Habitats Of The United States. Retrieved from https://www.nrc.gov/docs/ML1801/ML18019A904.pdf

DEE. (2019). *Wetlands and Climate Change*. Retrieved from environment.gov.au: https://www.environment.gov.au/water/wetlands/publications/wetlands-climate-change

Deka, J., & et.al. (2011). A multi-temporal remote sensing approach for monitoring changes in spatial extent of freshwater lake of Deepor Beel Ramsar Site, a major wetland of Assam. *Journal of Wetland Ecology, 5*, 40-47.

Dhankhar, L. (2017). *Gurugram: NGT issues notice to Haryana govt over C&D waste plant in Basai wetlands*. Retrieved from www.hindustantimes.com: http://www.hindustantimes.com/Gurugram/Gurugram-ngt-issues-notice-to-haryana-govt-over-c-d-waste-plant-in-basai-wetlands/story-ZJcCQTT5yEG55jgyp9icXL.html

Emerton, L. (2016). Economic Valuation of Wetlands: Total Economic Value. In C. F. al., *The Wetland Book.* doi:10.1007/978-94-007-6172-8_301-1

Emerton, L., & Bos, E. (2004). *Value Counting ecosystems as water infrastructure.* IUCN, Gland, Switzerland and Cambridge, UK.

ENVIS. (2016, 2 16). *Important Bird Areas (IBAs) in India*. Retrieved from ENVIS Centre on Wildlife & Protected Areas: http://wiienvis.nic.in/database/iba_8463.aspx

EPA. (2018). *Wetlands*. Retrieved September 12, 2020, from United States Environmental Protection Agency : https://www.epa.gov/wetlands/what-wetland

EPA. (2021). *Wetland Functions and Values.* U.S Environmental Protection Agency. Retrieved from https://www.epa.gov/sites/default/files/2016-02/documents/wetlandfunctionsvalues.pdf

EPA. (2021, March 31). *Why are Wetlands Important?* Retrieved 08 31, 2021, from www.epa.gov: https://www.epa.gov/wetlands/why-are-wetlands-important

Evers, Jeannie;. (2020). *Wetland*. Retrieved Dec 16, 2020, from national geographic: https://www.nationalgeographic.org/encyclopedia/wetland/

Extraordinary, T. G. (2017). *MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE NOTIFICATION.* Retrieved from https://police.py.gov.in/Wetlands%20(Conservation%20and%20Management)%20Rules,%202017.pdf

FAO. (2011). *THE STATE OF THE WORLD'S LAND AND WATER RESOURCES FOR FOOD AND AGRICULTURE Managing systems at risk.* The Food and Agriculture Organization of the United Nations and Earthscan. Retrieved from http://www.fao.org/3/i1688e/i1688e.pdf

Foote, A., Pandey, S., & Krogman , N. (1996). Processes of Wetland loss in India. *Environmental Conservation, 23*(1), 45-54. doi:10.1017/S0376892900038248

Gauger, A., & et, al. (2012). *The Ecocide Project 'Ecocide is the missing 5th Crime Against Peace'.* Project, University Of London, Human Rights Consortium. Retrieved from https://sas-space.sas.ac.uk/4830/1/Ecocide_research_report_19_July_13.pdf

Ghosh, J. (2018). *Destroying our Wetlands.* Frontline. Retrieved from http://www.frontline.in/columns/Jayati_ Ghosh/destruction-of-wetlands/article10006443.ece

Giri, C. P. (2012). *Remote Sensing of Land Use and Land Cover Principles and Applications.* (routledge, Ed.) CRC Press. Retrieved from https://www.routledge.com/Remote-Sensing-of-Land-Use-and-Land-Cover-Principles-and-Applications/Giri/p/book/9780367864385

IBCN. (2015). *Indian Bird Conservation Network*. Retrieved from Important Bird Areas in India-Haryana: http://ibcn.in/wp-content/uploads/2015/05/Haryana.pdf

IDR. (2021). *New Delhi most polluted capital city in the world for third time in a row.* Retrieved from https://idronline.org/news/indigenous-communities-in-assam-protest-construction-of-power-plant/

IEEP. (2013). *The Economics of EcosystemS anD Biodiversity for Water and Wetlands.* Institute for European Environmental Policy, United Nations Environment Programme. Retrieved from https://www.cbd.int/financial/values/g-ecowaterwetlands-teeb.pdf

International, B. L. (2021, October 28). *Data Zone*. Retrieved from http://datazone.birdlife.org/: http://datazone.birdlife.org/site/factsheet/basai-wetlands-iba-india

Jamil, K. (n.d.). *Environmental Impact of hyacinth carpet on water bodies.* Retrieved Aug 17, 2021, from msaapowai: https://msaapowai.tripod.com/waterhyacinth/waterhyacinthpaper.html

Jerath , N., & et al. (2014, February 14). Enhancing Community Participation for Conservation of Wetlands.

Joshi, P., Siddaiah, N. S., & Dixit, A. (2021). Urban wetlands of Delhi, India: water quality and pollution status. *Chemistry and Ecology, 37*(2), 104-131. doi:https://doi.org/10.1080/02757540.2020.1836164

Juwarkar, A., & et al. (1995). Domestic Wastewater Treatment Through Constructed Wetlands in India. *Water Science and Technology, 32*, 291-294.

Kashyap, K., Sahariah, D., & Ghosh, S. (2018). Monitoring Land Use/Land Cover Change And Consequent Effects On Wetland Environment-A Case Study Of Deepor Beel, Assam, India. *19th Esri India User Conference 2018* (pp. 1-7). esri India.

Kaul, H. A., & Sopan, I. (2012). Land Use Land Cover Classification and Change Detection Using High Resolution Temporal Satellite Data. *Journal of Environment, 1*(4), 146-152.

Kivaisi, A. (2001). The potential for constructed wetlands for wastewater treatment and reuse in developing countries: a review. *Ecological Engineering, 16*, 545-560.

Korukoglu , A., & et al. (2017). Evaluation of opinions related to the endangered Neopolis wetland in North Cyrus. *EURSIA Journal of Mathematics Science and Technology Education, 13*(6), 2215-2233.

Kumar, A., & Pandey, P. (2013). Assessing Spatial and Temporal Changes Using Remote Sensing and GIS in Harike Wetland, Punjab, India. *HYDRO 2013 INTERNATIONAL.* IIT Mardas ,India. .

Ladhar, S. (2002). Status of ecological health of wetlands in Punjab, India. *Aquatic Ecosystem Health & Management, 5*(4), 457-465.

Lambin, E. F., Geist, H. J., & Lepers, E. (2003, July 16). Dynamics Of Land-Use And Land-Cover Change In Tropical Regions. *Annual Review of Environment and Resources, 28*, 205–241. doi:10.1146/annurev.energy.28.050302.105459

Lan, F., Hao, W., Yuan, Y., Chaoya, W., Wang Sibo, & Tianyang, H. (2015). The Use and Non-Use Values of Ecosystem Services for Hechuan Wetland. *J. of Resources and Ecology, 6*(5), 302-309. doi:https://doi.org/10.5814/j.issn.1674-764x.2015.05.003

Lehner, B., & Doll, P. (2004). Development and validation of a global database of lakes, reservoirs and wetlands. *Journal of Hydrology, 296*, 1-22.

Mabwoga, S., Chawla, A., & Thukral, A. (2009, October 31). Assessment of water quality parameters of the Harike Wetland in India, a Ramsar site, using IRSS, LISS IV satellite data. *Environ Monit Assess*. doi:10.1007/s10661-009-1220-2

Mabwoga, S.O; Thukral, A.K. (2014). Characterization of change in the Harike wetland, a Ramsar site in India, using landsat satellite data. *A springer Open Journal, 3*. Retrieved from http://www.springerplus.com/content/3/1/576

Madgwick, J. (2021, Nov 07). *Restoring wetlands can help combat climate change*. Retrieved from aljazeera: https://www.aljazeera.com/opinions/2021/10/31/restoring-wetlands-can-help-combat-climate-change

Mahan, B. L., Polasky, S., & Adams, R. M. (2000, Feb). Valuing Urban Wetlands: A Property Price Approach. *Land Economics, 76*(1), 100-113. Retrieved from https://www.jstor.org/stable/3147260

Ministry Of Environment. (2017). *Wetlands (Conservation and Management) Rules, 2017*. Retrieved from http://www.indiaenvironmentportal.org.in: http://www.indiaenvironmentportal.org.in/content/447822/wetlands-conservation-and-management-rules-2017/

Mishra, S. (2018, Aug 29). *Opinion | Gurgaon Flooding: How Dying Rivers of NCR Are Having Their Revenge.* Retrieved from www.news18.com: https://www.news18.com/news/opinion/opinion-gurgaon-flooding-how-dying-rivers-of-ncr-are-having-their-revenge-1860139.html

Mitsch, J., & Gosselink, G. (2000). The value of wetlands: importance of scale and landscape setting. *Ecological Economics, 35*, 25-33.

MoHUA. (2015). *Pradhan Mantri Awas Yojana – Urban.* Government of India. New Delhi: Ministry of Housing and Urban Affairs. Retrieved from https://pmaymis.gov.in/

National Ocean Service. (2021). *Value of Coastal Fisheries and Wetlands*. Retrieved from coastalresilience.tamu.edu: https://coastalresilience.tamu.edu/home/wetland-protection/value-of-coastal-fisheries-and-wetlands/

Nature and Culture International. (2021, october 27). *Marine, coastal, and wetlands*. Retrieved from natureandculture.org: https://natureandculture.org/ecosystems/marine-coastal-and-wetlands/

Ogato, G. S. (2013). The Human Ecology of Wetlands in Least Developed Countries in Time of Climate Change: Policy and Strategy Implications for Wise Use and Conservation of Wetlands. *American Journal of Human Ecology, 2*(4), 127-138. doi:10.11634/216796221302476

Oliver Springate-Baginski . (2010). *REDD, forest governance and rural livelihoods The emerging agenda.* Retrieved from https://www.cifor.org/publications/pdf_files/Books/BWollenberg0101.pdf

Otterman, J. (1974, Nov). Baring High-Albedo Soils by Overgrazing: A Hypothesized Desertification Mechanism. *Science, 186*(4163), 531-533. doi:10.1126/science.186.4163.531

Papatheodorou, A., & Apostolakis, A. (2016). Hedonic price analysis. doi:10.4337/9781781001288.00015

Parsa, V. A., & Salehi, E. (2016). Spatio-temporal analysis and simulation pattern of land use/cover changes, case study: Naghadeh, Iran. *Journal of Urban Management, 5*(2), 43-51. doi:doi.org/10.1016/j.jum.2016.11.001

Pati, I. (2016, July 01). *Birds in Basai wetland face threat of rapid habitat loss*. Retrieved from www.hindustantimes.com: http://www.hindustantimes.com/Gurugram/birds-in-basai-wetland-face-threat-of-rapid-habitat-loss/story-gxTY62WeXzBzX76HUOEPDP.html

Phukon, B. (2020, March 02). *basai wetland*. Retrieved from bhrigzz.wordpress.com: https://bhrigzz.wordpress.com/birding-around-delhi-ncr/basai-wetland/

Prasad , S., & et al. (2002). Conservation of Wetlands of India- a review. *Tropical Ecology, 43*(1), 173-186.

Ramachandra, T. (2012). Conservation and Management of Wetlands: Requisite Strategies. *National Conference on Conservation and Management of Wetland Ecosystems.*

Ramachandra, T., Rajinikanth, R., & Ranjini, V. (2005). Economic Valuation of Wetlands. *Journal of Environmental Biology, 26*(3), 439-447. Retrieved from http://wgbis.ces.iisc.ernet.in/energy/water/paper/economic_valuation/introduction.htm

Ramsar. (1971). *What are wetlands?* Iram: Ramsar Convention on Wetlands . Retrieved from https://www.ramsar.org/sites/default/files/documents/library/info2007-01-e.pdf

Ramsar. (2012, Feb 2). *Wetland tourism: a great experience*. Retrieved from ramsar.org: https://www.ramsar.org/sites/default/files/documents/library/ramsar-wwd2012-leaflet-en.pdf

Ramsar. (2021, Nov 16). *INDIA*. Retrieved from ramsar.org: https://www.ramsar.org/wetland/india

RAND Corporation. (2021). *www.rand.org*. Retrieved from https://www.rand.org/topics/delphi-method.html

Richardson, C. (1994, March). Ecological Functions and Human Values in Wetlands: A Framework for Assessing Forestry Impact. *Wetlands, 14*(1), 1-9.

Romshoo, S., & Rashid, I. (2012). Assessing the impacts of changing land cover and climate on Hokersar wetland in Indian Himalayas. *Saudi Society of Geosciences*. doi:10.1007/s12517-012-0761-9

Rosen, S. (1974). Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy, 82*(1), 34-55. Retrieved from https://www.jstor.org/stable/1830899

Roy, M. B., & et. al. (2019). Study of Conservation and Wise Use of Two Important Indian Wetlands Using Contingent Valuation Technique. *EnvironmentAsia, 12*(2), 172-178. doi:DOI10.14456/ea.2019.39

Sala, O. E., & et al. (2000). Global Biodiversity Scenarios for the Year 2100. *Science, 287*(5459), 1770-1774. doi:10.1126/science.287.5459.1770

Sandeep, & et. al. (2015). Living Arrangement of Elderly in Haryana: A Case Study of District Rohtak. *International Journal of Indian Psychology, 2*(2). doi:10.25215/0202.049

Siew, M. K., & et al. (2015). Estimating willingness to pay for wetland conservation: a contingent valuation study of Paya Indah Wetland, Selangor Malaysia. *Procedia Environmental Sciences, 30*, 268 – 272.

Singh, H. (1997). Contingent Value Measurement Of Coastal Wetlands: A Case Study Of New Jersey. *Middle States Geographer, 30*, 50-54.

Solanki, V., & Joshi, A. (2017). Disappearing Wetland: A Study of Basai Wetlands, Haryana (India). *International Journal of Economic Research, 14*(20), 681-691. Retrieved from https://serialsjournals.com/abstract/95934_ch_55_f_-_20._vipin.pdf

Spash, C. L. (2000). Ecosystems, contingent valuation and ethics: The case of wetland re-creation. *Ecological Economics, 34*(2), 195-215. doi:10.1016/S0921-8009(00)00158-0

Stottmeister, U., & et al. (2003). Effects of plants and microorganisms in constructed wetlands for wastewater treatment. *Biotechnology Advances, 22*, 93-117.

Sunkara, N. P., & et al. (2001). Conservation of wetlands of India - A review. Retrieved from https://www.researchgate.net/publication/238087971_Conservation_of_wetlands_of_India_-_A_review/citations#fullTextFileContent

tcpharyana;. (2012). Retrieved from https://tcpharyana.gov.in/Development_Plan/ColouredCopy/GMUC_DDP_2031.pdf

Turner , R., & et al. (2000). Ecological-economic analysis of wetlands: scientific integration for management and policy. *Ecological Economics, 35*, 7-23.

UNEP. (2021, Nov 06). *human-made wetland*. Retrieved from leap.unep.org: https://leap.unep.org/knowledge/glossary/human-made-wetland

United Nations. (2021, October 27). *General Assembly debate underscores need to deliver on climate action*. Retrieved from UN News: https://news.un.org/en/story/2021/10/1104052

Upreti, G. (2016). *Basai Wetland Is A Bird Sanctuary Hiding Deep In Gurugram's Concrete Jungle And It Needs Your Help*. Retrieved from www.tripoto.com: https://www.tripoto.com/trip/basai-wetland-Gurugram-itinerary

Verburg, P. H., Chen, Y., Soepboer, W., & Veldkamp, A. (2000). GIS-based modeling of human-environment interactions for natural resource management. *4th International Conference on Integrating GIS and Environmental Modelling: Problems, Prospects and Research Needs.* Alberta, Canada. Retrieved from https://core.ac.uk/download/pdf/29308966.pdf

Verma, M. (2001). *Economic Valuation of Bhoj Wetlands for Sustainable Use.* Bhopal: INDIAN INSTITUTE OF FOREST MANAGEMENT. Retrieved from http://iifm.ac.in/wp-content/uploads/bhojwetlands2001.pdf

Vermont. (2021). *WETLAND FUNCTIONS AND VALUES: RECREATIONAL VALUES AND ECONOMIC BENEFITS*. Retrieved from AGENCY OF NATURAL RESOURCES Department of Environmental Conservation: https://dec.vermont.gov/watershed/wetlands/functions/benefits

Wadood, S., & Ali, A. (2016). Economic Valuation of Rural Wetlands and Household Food Security: A Case Study from the North-West Bangladesh. *MPRA Paper 77068*. Retrieved from https://ideas.repec.org/p/pra/mprapa/77068.html

Water and the Environment. (2021, october 27). *Ramsar wetland type classification*. (Department of Agriculture) Retrieved from www.awe.gov.au: https://www.awe.gov.au/water/wetlands/ramsar/wetland-type-classification

Whitehead, J. C. (1990). Measuring Willingness-To-Pay For Wetlands Preservation With The Contingent Valuation Method. *WETLAND, 10*(2).

Woodward, R., & Wui, Y.-S. (2001). The economic value of wetland services: a meta-analysis. *Ecological Economic, 37*, 257-270.

Wu , J., & et al. (2013). Intercalibration of DMSP-OLS night-time light data by the invariant region method. *International Journal of Remote Sensing, 34*(20), 7356-7368. doi:https://doi.org/10.1080/01431161.2013.820365

Z, E., & et.al. (2016). Constructed wetlands as a Sustainable Wastewater Treatment Method in Communities. *Procedia Environmental sciences, 34*, 605-617.

Zhang, L., & et.al. (2010). A review of published wetland research, 1991-2008: Ecological engineering and ecosystem restoration. *Ecological Engineering, 36*, 973-980.

Annexure- I

Assessing the Total Economic Value of a Wetland: A Case Study of Basai

Contingent Valuation questionnaire for the valuation of ecosystem functions of Basai Wetland

PERSONAL INFORMATION

1.	Village /town name	
2.	Respondent's Name	
3.	Age	
4.	Education	Illiterate… ..... 1 Primary..... 2 Middle ..... 3 Matriculation… ..... 4 Senior Secondary .....5 Graduate… ..... 6 Post graduate… ..... 7 Others (specify) 8
5.	Occupation	Unemployed… ..... 1 Agricultural Labourer.....2 Farmer..... 3 Artisan… .....4 Shop owner.....5 Business/industrialist.....6 Daily wager /labourer .....7 Private service..... 8 Government service.....9 Retired/pensioner.....10 Other (specify) 11
6.	Income (if economically active) monthly	
7.	Caste	General .....1 Scheduled Caste….....2 Backward Caste… .....3 Others 4
8.	Family Type	Joint…..1 Nuclear….2
9.	House ownership	Own… .....1 Rented..... 2 Gifted… .....3 Rent free 4

10.	Ownership	Wife… .....1 Self……..2 Others in family (specify) 3
11.	Type of house	Kutcha.....1 Semi-Pucca ..... 2 Pucca.....3
12.	Area	Urban……..1 Rural……2
13.	Are you a member of an environmental organization?	Yes……..1 No……2
14.	If yes, please explain in detail	

RESPONDENT'S PERCEPTIONS

15	Have you any previous knowledge of wetlands and their function	No…..1 Yes…….2 Unsure……..,,,3
16	What according to you is the best agency to conserve biodiversity in the Basai Wetland?	State Government……1 Fisheries Department……2 HSVP ……..3 Village Panchayat……4 A coalition of State agencies and NGO's…..5

17. Give rating according to Likert scale (1 for strongly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 for strongly agree) for the following services of Basai wetland

Services / Ratings	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
The environmental services that the Basai wetland perform for us are invaluable and cannot be replaced if destroyed.					
The Government should not pursue developmental programs that damage the biodiversity of the Basai Wetland.					
It is the duty of the people to protect their environment. Hence, they should take the initiative.					
The Basai wetland supports 240 species of birds. It does not matter if a few of these species are lost.					
It does not matter if the wetland is reclaimed for development activities.					

18. Give rating according to Likert scale (1 for strongly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 for strongly agree) for the following services of Basai wetland

Services / Ratings	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Environmental quality degradation in Haryana will become more widespread in years to come.					
Are you satisfied with the environment quality of Basai Wetland?					
Deterioration in the quality and services provided by the Basai Wetland ecosystem will affect indirect users of this resource.					
In the absence of any concrete initiatives to conserve biodiversity, the people will take up the initiative.					
I may donate money to conserve biodiversity of the Basai Wetland ecosystem.					

19.	Do you or your household buy and eat fish and other fishery products?	Yes……1 No…….2
19.1	If no then	Do not like fish Too expensive Too many bones….1 Do not like the smell…2 Got sick last time…….3 Religious reasons…….4 Allergic to fish Do not know how to cook….5 Other (specify)……6
20.	Any other resource, you use from Basai Wetland?	Yes….1 No……2
20.1	If yes please specify	

(Please show the Charts to the Respondent)

Situation A: Status of the Basai Wetland ecosystem and its delivery of services in 2020 if current environment management remains the same.	**Situation B**: Status of the Basai Wetland ecosystem and its delivery of services in 2020 if managed by a Wetlands (Conservation and Management) Rules, 2017, India
1.A Household/Industrial Waste dissemination function ▪ Congested water channel ▪ Accumulated waste ▪ Contamination of water ▪ Spread of communicative diseases via Mosquitoes, etc. ▪ Non degradable plastic and industrial pollutants ▪ Increased pollution	1.B Household / Industrial Waste dissemination function ▪ Cleaner water channels & canals ▪ Prompt disposal of wastes ▪ Good water quality ▪ Free from communicative diseases. ▪ The people of Basai will be safe from attacks of mosquitoes and such insects. ▪ Healthy Environment
2.A Recreational value ▪ Influx of tourism at the expense of the environment	2.B Recreational value ▪ Encourage eco-friendly tourism activities
3. Environment value ▪ No migratory birds ▪ Ground water problem ▪ Flash Floods	3.Environment Value ▪ Breeding Place for Migratory birds ▪ Enough ground water availability ▪ It will absorb excess rain and fill the aquifers

21. Please rate the consequences of the two scenarios to Likert scale (1 for strongly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 for strongly agree) for the following services of Basai wetland.

Services / Ratings	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Situation A					
Situation B					

VALUATION QUESTIONNAIRE

22.	If by 2022, the Wetlands (Conservation and Management) Rules, 2017, Basai wetland is to achieve the desired environmental quality explained in section B, we will have to start taking many additional environmental measures now both in and around the Basai Wetland and at the State and National level. The additional environmental measures that we will have to take in the city to achieve this environment are going to cost money. Would you be willing to share this cost?	Yes…..1 No….2 Unsure ..(3)
23.	Assume that a body, reputed for doing efficient and honest work undertakes the task of protecting the Basai Wetland from further degrading activities like Pollution, large scale Basai Wetland land reclamation, waste dumping and such other external activities so that we can at least maintain the current Scenario from further degradation will you be willing to support such a move?	Yes…..1 No….2 Unsure ..(3)
24.	If you are not willing to contribute, which of the following reasons best describes why you would not be willing to pay anything?	
	I don't believe my payment will help in stopping the degradation of the Basai Wetland……..1 It is not worth anything to me……2 I can't put a rupee value on improved water quality……..3 It is the Government's duty to pay for such expenses……4 I oppose this type of question……5 Other, please specify_____..6	

25.	Suppose that the additional environmental measures would mean that your household would have to contribute a onetime payment of ___10, 20, 50, 100 Rupee__ to achieve the environment which can be expected as a result of a more stringent environment policy by the year 2022, given your budget constrain would you be willing to contribute amount?	Yes…..1 No….2 Unsure ..(3)
26.	What is the maximum amount of money that your household would be willing to contribute to achieve the environmental quality which can be expected as a result of a more stringent environment policy initiated by the Wetlands (Conservation and Management) Rules, 2017, India by 2022? Would you be willing to pay more than the amount stated above? The MAXIMUM amount is Rs.…….	Rs…….
27.	Please explain the main reason, which played an important role in determining your maximum amount.	

DO YOU HAVE ANY COMMENTS TO MAKE ABOUT THIS SURVEY OR THE ENVIRONMENT IN THE BASAI WETLANDS? IF SO, PLEASE USE THIS SPACE.

_____

_____

THANK YOU VERY MUCH FOR TAKING THE TIME TO COMPLETE THIS SURVEY. IT IS

GREATLY APPRECIATED

Annexure- II

Hedonic Pricing Questionnaire

Assessing the Total Economic Value of a Wetland: A Case Study of Basai

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Date and time of Interview: _____.

SECTION 1: PERSONAL DETAILS OF THE HOUSEHOLD

1. Name of the Head/Main respondent:	2. Age:
3. Sex:	4. Religion
5. Caste:	6. Marital status:
7. Nationality/State:	8. Monthly Income:

9. Are you a migrant?

   Yes No

   If yes, then

   a. How much time did it take to get a rented accommodation the first time you arrived? _____months
   b. How many times have you changed your accommodations so far? _____times
   c. Do you want to change it further? (Yes/No)
   d. If yes why? _____

10. How long have you been in Basai /Gurugram/ Dhanwapur ? _____years
11. Address of the respondent
    a. Place of residence/detail location of the house: _____
    b. Phone number: _____
12. Please use the codes given Below (Q12-16)?
13. Educational Qualification of the Head*: (Please use the codes given below) _____
14. Educational Qualification of the Spouse*:(Please use the codes given below) _____
15. Employment/Occupation of the Head*:(Please use the codes given below) _____
16. Employment/Occupation of the Spouse*: (Please use the codes given below) _____

*For Nos. 12 to 14 please refer to the code of table given below:

For Qualification	Code Number	For Occupation	Code Number
Illiterate	0	Unemployed	0

Literate but less than Secondary	1	Daily wage earner	1
Secondary	2	Self Employed/business	2
Higher Secondary	3	Private Service	3
Graduate and above	4	Public Service	4
Any other (Please Specify)	5	Any other (Please Specify)	5

17. Family size?

Adult		Children		Total
Male	Female	Male	Female	

18. Do you have any personal vehicle? [Yes/No]

If yes, then

(a) Two-wheeler [ ] (b). Three-wheeler [ ] c. Four-wheelers [ ]

SECTION II: PARTICULARS ON HOUSING

A. Identity of Property rights/Ownership:

19. What is the nature of ownership of the house you now reside in? (Please tick any of the relevant choices)

a. Ownership [ ]	b. Rented [ ]
If Ownership, then?	If Rented, then how much
Family inheritance [ ]	you pay?
Purchased	

i. Owner (already paid) [ ] ii. Still paying instalment [ ] Constructed by self on i. Own land [ ] ii. Leased land [ ] Cost of buying the house/construction: Rs. _____ f. Other conditions (please specify): _____	

20. Do you have houses to let on rent? (Please tick any relevant choice)
    a. Yes [ ]
    b. No [ ] (go to 23)

21. State the objective of buying/constructing your house. (Please tick any relevant choice)
    a. For renting [ ]
    b. For staying [ ]
    c. For both staying & renting [ ]

22. How long it took to get a tenant/renter for the first time after construction/purchase (in months)?
    a. _____months booked in advance. b. _____months later.

23. Suppose you have to pay monthly house rent for your house you are now living in; how much would you pay? Rs. _____

24. If Family inheritance:
    a. If you are to sell your house, how much would you charge for it? Rs. _____
    b. What is the growth of land price during the last 10 (ten) years: From Rs. _____to Rs. _____ per sq. ft.
    c. What is the growth of house price during the last 10 (ten) years: From Rs. _____to Rs. _____ (Specify house type)

25. How many houses do you have in Basai/ Dhanwapur/ sector? _____Nos.

B. Housing (Structural) Characteristics

26. Type of house
    a. Kutcha
    b. Semi-Pucca
    c. Pucca

27. Does your house have (Please tick any relevant choice)
    a. Concrete/Brick fencing walls [ ]
    b. Fencing other than concrete/brick [ ]
    c. No fencing [ ]

28. The exterior part of your house is mostly made up of (please tick)
    a. Concrete [ ]
    b. Mud [ ]
    c. Both [ ]

29. The interior walls of the house are made up of (please tick)
    a. Paneled /tiles [ ]
    b. Bricks [ ]
    c. Mud [ ]
    d. (a), (b) and (c) [ ]

30. Floor of the house (please tick)
    a. Marbles/Tiles [ ]

b. Concrete [ ]
c. Earth [ ]
d. Wood [ ]
e. Any other [ ]

31. Roof of the house (please tick)
    a. Concrete [ ]
    b. Tin sheet/asbestos sheet/slate [ ]
    c. Other than (i) and (ii) [ ]
32. Number of floors in the house _____

33. Which floor you stay in? [G/1st/2nd/and so on/_____]

34. Please specify the number of
    a. Bedrooms [ ] nos.
    b. Living/drawing rooms [ ] nos.
    c. Toilet/bath [ ] nos.
    d. Store room [ ] nos.
35. Nature of toilet:
    a. Attached [Yes/No]
    b. With Commode (Indian/Western) [Yes/No]
    c. With covered concrete Septic tank [Yes/No]
36. If no toilet, how much more would you pay to have an attached toilet?

    _____

37. Nature of bathroom
    a. Attached [Yes/No]
    b. With concrete floor and wall [Yes/No]
38. If no bathroom, how much more would you pay to have an attached bathroom?

    _____
39. House length _____, House Width _____
40. Please specify the area of the house _____ (square feet)
41. What is the present age of the house _____ Years?
42. Please specify the facilities available along with the house at present. (please tick)
    a. Playground or courtyard [Yes/ No]
    b. Garage
        i. Double car [ ]
        ii. Single car [ ]
        iii. No Garage [ ]
    c. Vegetable garden [Yes/ No]
    d. Veranda/Porch/Balcony/ compound/courtyard [ ]

e. Any other (please specify) _____

43. Please specify the utilities attached with the house at present.

a. Electricity [ ]
b. Cable connection/ Dish TV [ ]
c. Landline phone connection [ ]
d. Refrigerator [ ]
e. Almirah/(cupboard in the bedroom) [ ]
f. Cupboard for Kitchen wares [ ]
g. Table [ ]
h. Chair [ ]
i. Other (please specify): _____

44. If electricity for purposes other than lighting (Please tick all or any relevant choice)

i. Cooking [ ] ii. Heating [ ]
iii. Cooling [ ] iv. Drying [ ]
v. Water pump [ ] vi. Other purpose (Specify)
_____

45. What is the major source of drinking water?

a. Bottled-water [ ] b. Tap/RO [ ] c. Tube well/Hand pump [ ]

46. Does the house have water connection (Please tick any relevant choice) [Yes/No]

If Yes, Connection is available then

a. In the house [ ]
b. Outside the house [ ]

If No, how do you collect water?

c. From public tap [ ]
d. Buy from vendors [ ]
e. Ring well/tube well [ ]
f. From neighbour's place [ ]
g. Any other (please specify) _____

47. How far is the house from the nearby well/public tap? _____ km

48. From which source do you get your tap water connection?

a. Govt. [ ]
b. Private [ ]

49. Supply of water

a. 24 hours [ ]

b. Good/more than sufficient [ ]
c. Just enough [ ]
d. Insufficient [ ]

50. Do you have any water storage facility?
    a. Yes [ ]
    b. No [ ]
    c. If yes, how many days can it last for all domestic purposes? _____days
51. Are you satisfied with the quality of the water you get? [Yes/No]

52. If No, how much more would you pay to get good water? _____

53. What is the nature of the sewer of the house? (please tick)
    a. Covered [ ]
    b. partially covered [ ]
    c. opened [ ]
    d. Free flow [ ]
    e. slow movement [ ]
    f. clogging [ ]
54. For tenant/renter:
    In your opinion, the condition of the house you are now living is
    a. Excellent [ ]
    b. Medium [ ]
    c. Unsatisfactory [ ]

55. For tenant/renter: Given your present income and your present monthly house rent how much **more** rent is you willing to pay for an excellent house? Rs._____

56. For house owners/ tenant
    In your opinion, the condition of the house you are now living is
    i. Excellent [ ]
    ii. Medium [ ]
    iii. Unsatisfactory [ ]
    iv. Is your house located near a river/ stream/lake? [Yes/No]

57. Have you changed houses? (please tick)
    a. No [ ]
    b. Yes [ ]

c. If Yes, when have you shifted to this present house? _____ Months ago/Years ago.

d. What are the main reason(s) for shifting to this present house? (Please tick all or any relevant choice)

i. For more space [ ]

ii. For coming nearer to my working place [ ]

iii. For coming nearer to children's institution [ ]

iv. For location constraint of the house [ ]

v. Neighbourhood [ ]

vi. Natural Environment [ ]

vii. Security [ ]

e. What is the total price or monthly rent of the house at the time of occupying and now?

i. Total Monthly Rent Rs._____ in _____ (Year) : Now Rs. _____

ii. Total purchase Price Rs. _____ in _____ (Year) : Now Rs _____

C. Locational characteristics

58. Would you pay more to be near a clean river/stream/lake? [Yes/No]

59. Does your house/compound get flooded during monsoon? [Yes/No]

60. If yes, how much more would you pay to avoid it._____

61. Approach road is available
    a. Yes. It is made of Black top or concrete [ ]/stone chips and earth [ ]/ earth [ ]
    b. No. Please specify the distance from it _____ km.

62. How long do you have to wait for public transport from the nearest point from your house?
    _____ minutes

63. Would you like to reside near Old Market or New market or Super market area?
    a. Yes
    b. The main reason is _____
    c. No
    d. The main reason is _____

64. Please give the approximate distance of your house from
    a. Public Park _____ km
    b. Zoological Park _____ km
    c. Nearest forest cover _____ km
    d. Wetland _____ km

65. Would you like to reside near Zoological Park, Public Park, Wetland or forest area?
    a. Yes
    b. The main reason is _____
    c. No
    d. The main reason is _____

66. How much **more** would you like to pay to reside near
    a. Zoological Park Rs. _____
    b. Public Park Rs. _____
    c. forest area Rs. _____

d. Wetland Rs _____

67. From your house can you see (Please tick all or any relevant choice)
    a. Natural site/green cover [ ]
    b. Forested area [ ]
    c. Good architectural/build environment or construction(s) [ ]
    d. Wetland [ ]

68. Did you know about Basai Wetland near your are. Yes [ ] No [ ]

69. What is the quality of water present in wetland?
    Very good[ ] Good[ ] Neutral [ ] Very bad[ ] Bad[ ]

70. How much would you like to pay to be able to view the following from your house
    a. Natural site/green cover? Rs. _____
    b. Forested area? Rs. _____
    c. Good architectural/build environment or construction(s)? Rs. _____
    d. Wetland Rs. _____

71. Is your house located near any of the following? (Please tick all or any relevant choice)
    a. Garbage bin/dump yard [ ]
    b. Public sewer or drain [ ]
    c. Polluted stream [ ]
    d. Heavy traffic road or junction [ ]
    e. Commercial area or centre [ ]
    f. Playground or concert hall [ ]
    g. Community hall/town hall [ ]

72. How much are you willing to pay to reside at a location with **some** distance away from
    a. Garbage bin/dump yard? Rs. _____
    b. Public sewer or drain? Rs _____
    c. Polluted stream? Rs. _____
    d. Heavy traffic road or junction? Rs. _____
    e. Commercial area or centre? Rs. _____

f. Playground or concert hall? Rs. _____
g. Community hall/town hall? Rs. _____

73. Approximate distance of the school or institution of dependent children
    a. Below Lower Primary (Till Class III) _____km
    b. Above Lower Primary (Class IV & above) _____km

74. What is the distance to the nearest?
    a. School _____ km
    b. Temple _____ km
    c. Church _____ km
    d. Mosque _____ km
    e. Other places of worship _____ km

75. Approx. distance to the nearest
    a. Government office complex _____km
    b. Shopping complex _____km
    c. Slum _____km

76. Is there any plot/house around your neighbourhood which is has been left unattended for quite sometimes? Yes [ ]/No [ ]

77. Quality of the available Municipal services/utilities in your locality in the following aspects
    [Note that: VG-very good; G-Good; N-normal; NM-not up to the mark and VB-very bad]
    a. Street lightings: VG [ ]/G [ ]/N [ ]/NM [ ]/VB [ ]
    b. Roads conditions: VG [ ]/G [ ]/N [ ]/NM [ ]/VB [ ]
    c. Footpath: VG [ ]/G [ ]/N [ ]/NM [ ]/VB [ ]
    d. Public drains/sewer: VG [ ]/G [ ]/N [ ]/NM [ ]/VB [ ]
    e. Garbage collections: VG [ ]/G [ ]/N [ ]/NM [ ]/VB [ ]

78. Which locality within the Municipal Area would you prefer to stay other than the present location?

_____ (Name of the locality)

79. What is the main reason for such preference? (please give one reason) and how much more are you willing to pay to shift to this locality Rs?

_____

80. Do you prefer to stay in the locality of your own community/own language? Yes [ ]/No [ ]

81. Do you prefer to stay in the locality with the majority of the resident professing your religion?

Yes [ ]/No [ ]

82. Would you prefer to reside near any place of worship?
    a. Yes (Please name one of them) _____
    b. No (Please give one reason) _____

83. Would you prefer to reside near equally educated neighbours?
    a. Yes (Give one main reason) _____
    b. No (Give one main reason) _____

Thank you for sparing your most valuable time in cooperating with this effort