GEODESY PROJECT

REPORT

On

Climate change and Gepang Gath lake expansion since 1970.

BY

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DISCIPLINE OF CIVIL ENGINEERING

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CANDIDATE'S DECLARATION

We hereby declare that the project entitled "**Climate Change and Gepang Gath lake expansion since 1970**" submitted in partial fulfillment for the award of the course CE302 degree of Bachelor of Technology in Civil Engineering completed under the supervision of **Dr. Mohd. Farooq Azam**, Assistant Professor IIT Indore is an authentic work.

Further, we declare that we have not submitted this work for the award of any other degree elsewhere.

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Abstract

Gepang Gath is one of the most significant proglacial lakes in the Chandra basin of western Himalaya. Proglacial lakes are large bodies of water that have built up at the edges of glaciers or ice sheets. According to geospatial research, Gepang Gath lake showed significant expansion in area and volume over last 50 years. One of the major contributors in the expansion of lake is the increased melting of glaciers over this period. Himalayas has one of the largest basin of snow and glaciers, which act as a significant freshwater storage facility.

Scientific studies have classified the lake as vulnerable to threats like lake outburst floods in the future because of its incredibly high volume and steep lake cliffs. The location of features like lake areas was mapped using field research and remote sensing methods. The resulting calculated areas will give us information on the lake's present expansion/shrinkage.

1. Introduction

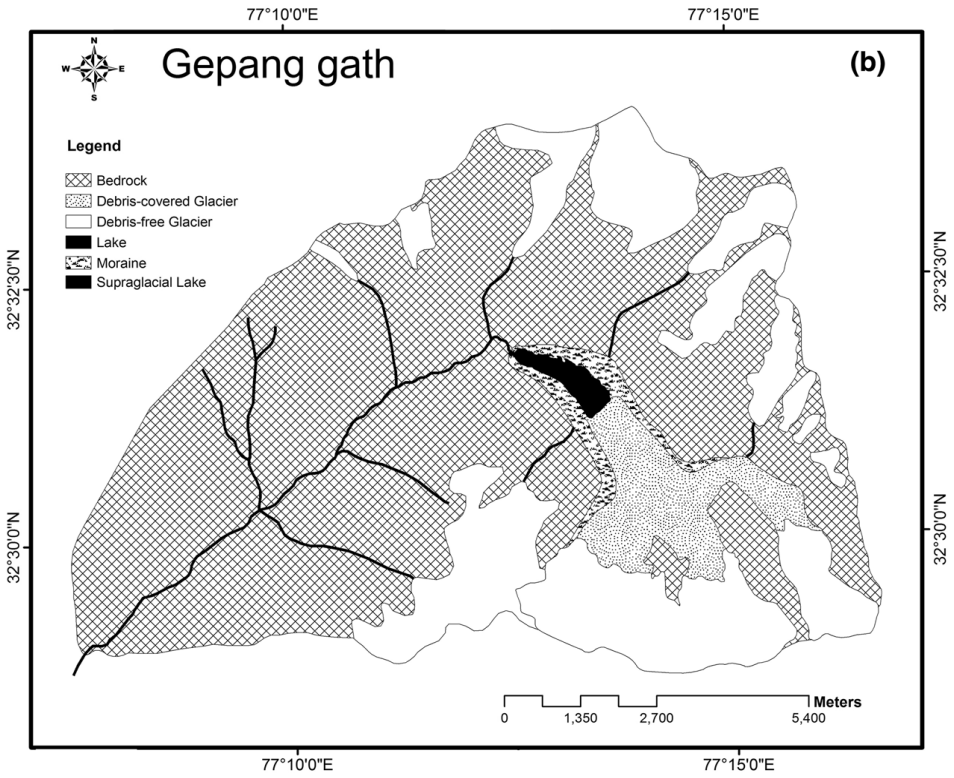
The objective of this study is to learn more about the Gepang Gath lake expansion over a period of previous 50 years (since 1972). The shrinkage of glaciers leads to the formation of proglacial lakes. The steadily rising temperature cause the glacial ice to melt which leads to the formation glacial lakes. Due to the expansion of these glacial lakes, the dams in these lakes are now in danger since their failure would lead to flood and outbursts, which would be a major threat to people lives and property. The existence of permafrost in the surrounding steep slopes of the lake makes it vulnerable to failure.

Glacial lake Outburst Floods : A glacial lake outburst flood is a flood caused by the sudden release of water dammed by a glacier due to dam failure. This flooding happens as a result of the accumulation of melting glaciers behind glacial dams. The rise in temperature due to many man-made activities that causes environmental pollution accelerates the melting of glaciers which leads to glacial lake outburst floods.

2. Study Area

Gepang Gath lake is a glacial lake located in the Gepang Gath glacier region of Himachal Pradesh. This glacier is one of the largest glacier located in the Chandra basin : Lahaul and Spiti district of Himachal Pradesh. The basin of lake is around 0.8 square kilometers of area located at an elevation of 4063 m above mean sea level whereas the glacier is around 14.9 square kilometers of area.

The glacier extends from latitude 32°30’ N to 32°32’30’’ N and longitude 77°10’ E to 77°15’ E. Geospatial studies carried out in Gepang Gath lake showed significant expansion in area and volume over the last 50 years. The Lake has expanded from 0.1 to 0.8 square kilometers between 1971 and 2014. This increase is due to climatic change which leads to increase in melting of the glacial snow. This rate of melting raises concerns as the Himalayan glaciers are prone to natural disasters.



LITERATURE REVIEW

climate change:

Climate change is the long-term alteration of temperature and weather patterns. These alterations in temperature are due to the changing solar cycle. burning of fossil fuels like coal, oil, and gas releases greenhouse gasses into the atmosphere was the main cause of climate change

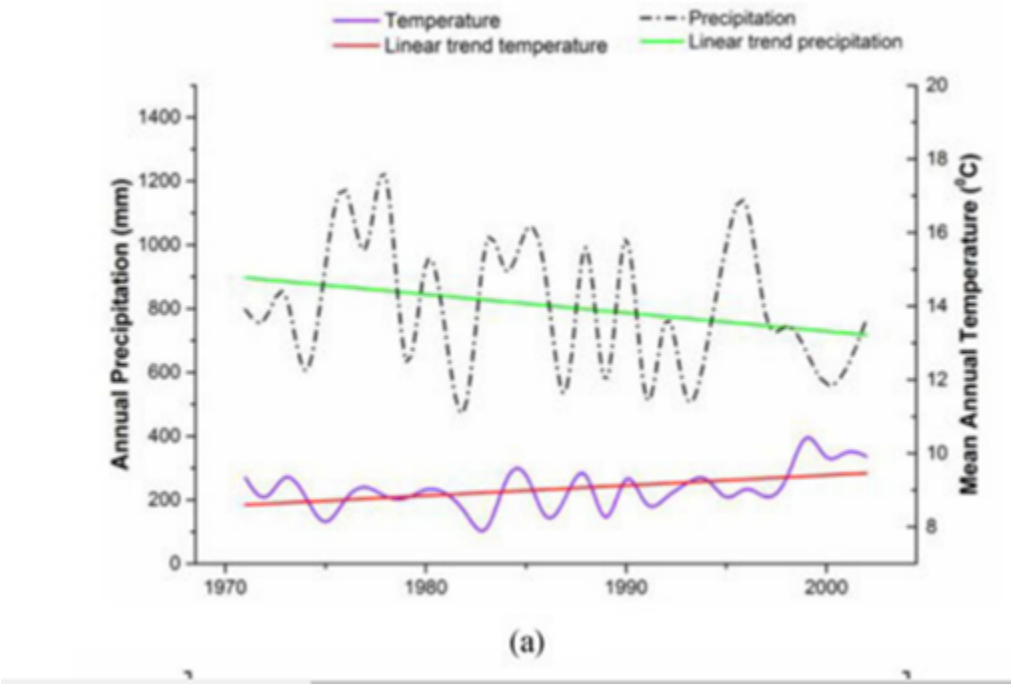
Temperature, humidity, precipitation, and wind speed are the factors that affect climate change due to variations in these factors climate is changing continuously

The environment is severely impacted by climate change. Because of this, between 1880 and 2012, the surface of the land and the water warmed by 0.85(0.65 to 1.06) degrees Celsius. It is believed that high-mountain ecosystems, such as those with snow, glaciers, and permafrost, are especially susceptible to climatic change. Glacier retreat as a result of global warming is regarded as evidence of climate change, and this has long-term effects on the ecology and environment.

Around Chandra Basin, the following are the changes in variations observed in temperature from recent years

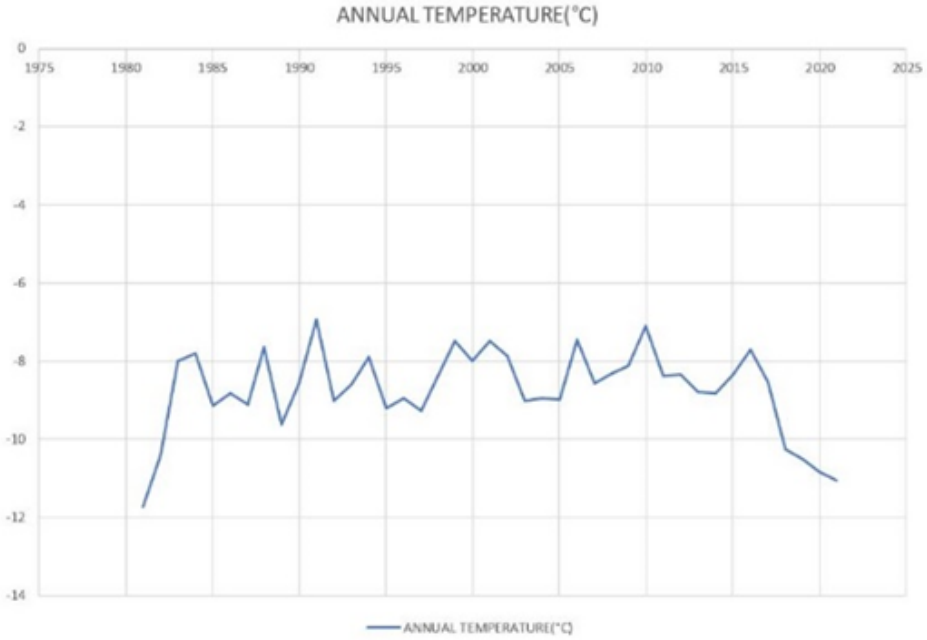
Temperature and precipitation graph of Chandra basin between 1970 to 2011:

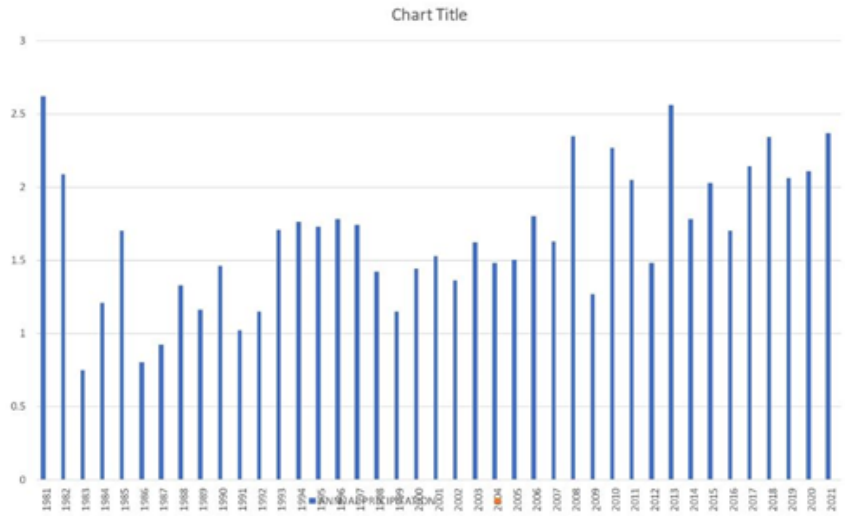
The below graph gives the information of average annual temperature and precipitation of the Chandra basin in which Gepang Gath glacier lake is located:



(a)

The below graph shows the change in temperature of Chandra basin annually between 1975 to 2022





The bar graph is showing the change in annual precipitation from 1980 to 2021, years on the X-axis, and the corresponding magnitude of precipitation on the Y-axis

The above-observed trend gives a clear idea of annual temperature and precipitation in the Chandra basin between 1970 to 2011. There is a linear increase in temperature from 1970 to 2020 and precipitation followed a decreasing trend between 1970 to 2020.

The annual temperature in 1982 is about -11 degrees Celsius and it increased to about -7 degrees Celsius between 1990 to 1995 and -15degree Celsius temperature was noted between 2015 to 2020 this shows irregularity in the trend of temperature but most likely it was found to be increasing continuously. Due to this change and increase in temperature, the glacier starts to melt.

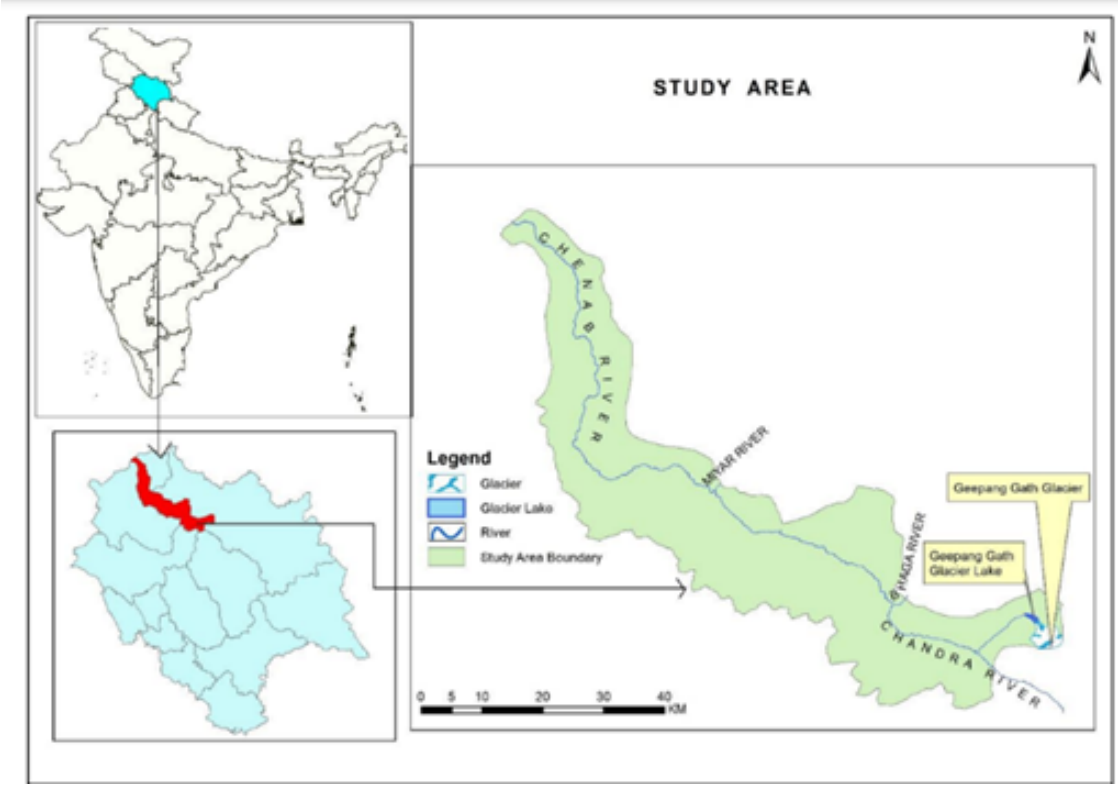
Due to weak monsoons, the precipitation is decreasing linearly

The main cause of glacier recession was a linear increase in temperature and this resulted to the formation of glacier lakes

Gepang gath lake is formed due to glacier recession of gepang gath glacier

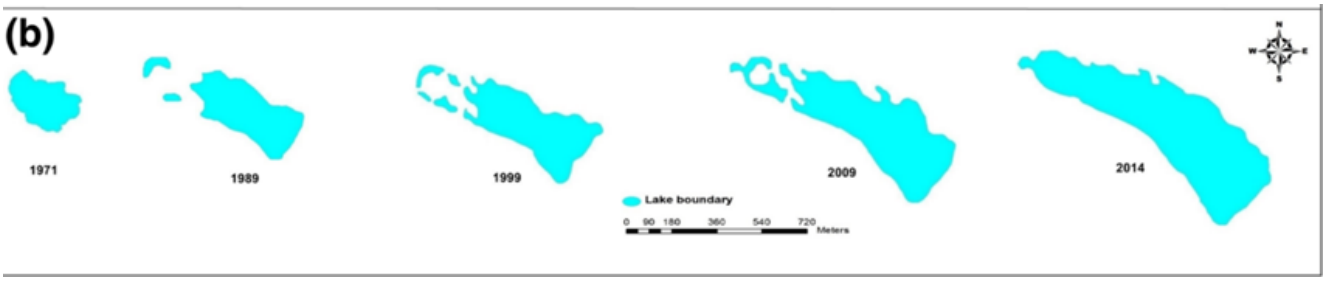
Gepang Gath Lake:

GEPANG Gath lake is a proglacial lake located in Chandra basin. The source of water for this lake is from the melt from gepang gath glacier lake



As a result of global warming and an incremental rise in temperature every year in this region GEPANG Gath glacier is melting and the corresponding gepang gath lake volume is increasing. The impact of precipitation-related water on the expansion of the lake can be disregarded because of the diminishing trend in precipitation and the surface drainage of Gepang Gath Lake, which permits excess water to overflow.

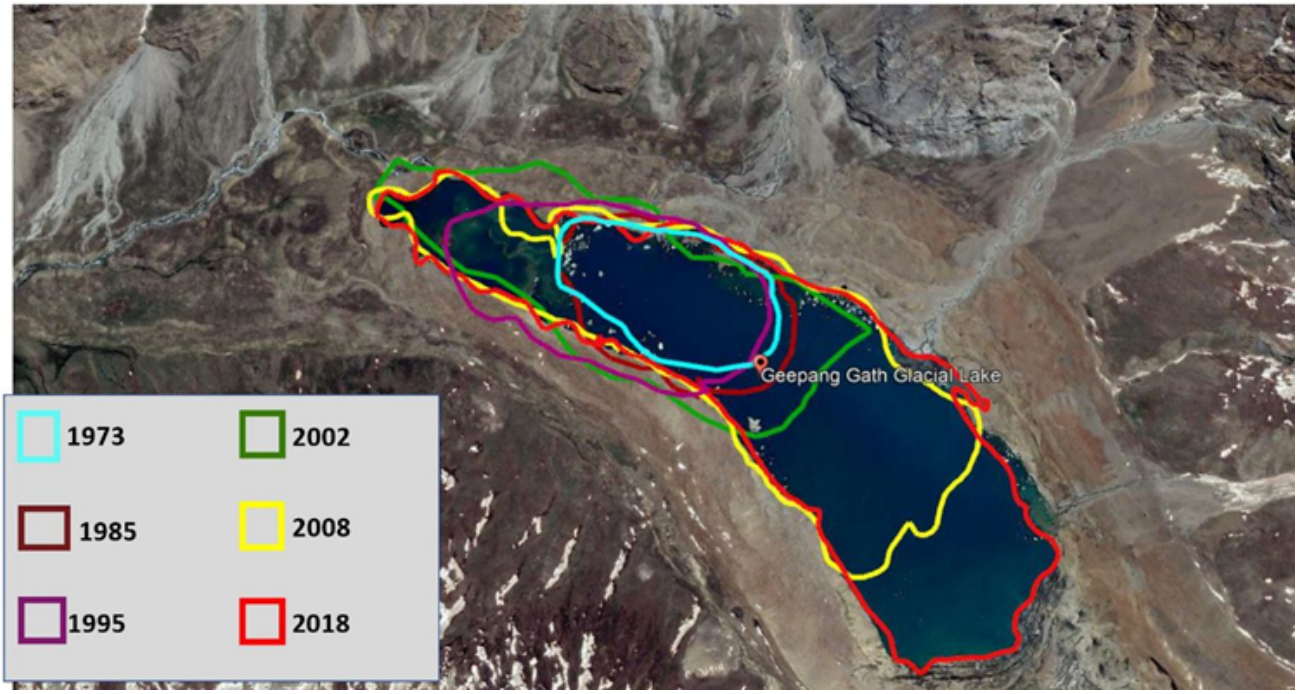
Let us see the trend of gepang gath lake expansion between 1970 to 2020



The annual increase in the area and volume of the lake can be used to calculate lake expansion. Between 1972 and 2018, the lake's volume and area grew from 1.9 to 23.6 million m3 and 184728 to 865977 m2, respectively.

The evolution and growth of glacial lakes is closely related to climate change and topographic conditions

Using google earth software, USGS and QGIS 3.22.2 lake expansion was found to be as shown



The area measured while drawing the shape files is mentioned below :

YEAR	AREA IN m2
1973	184728
1985	239998
1995	348334
2002	485374
2008	677702
2018	865977

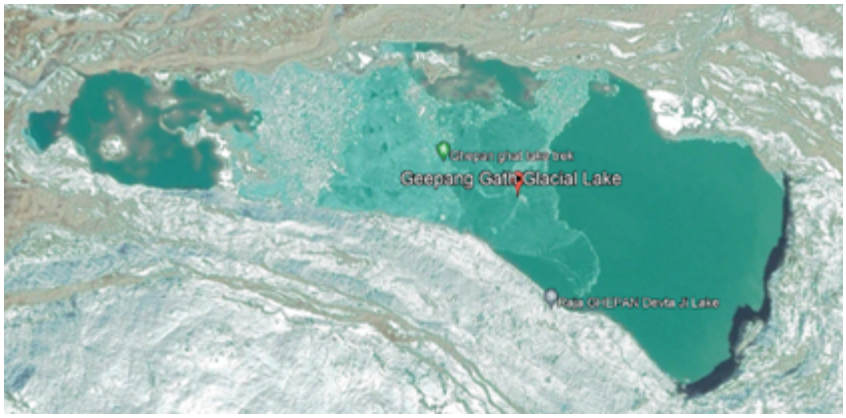


Image of gepang gath lake in 2010 downloaded from google earth

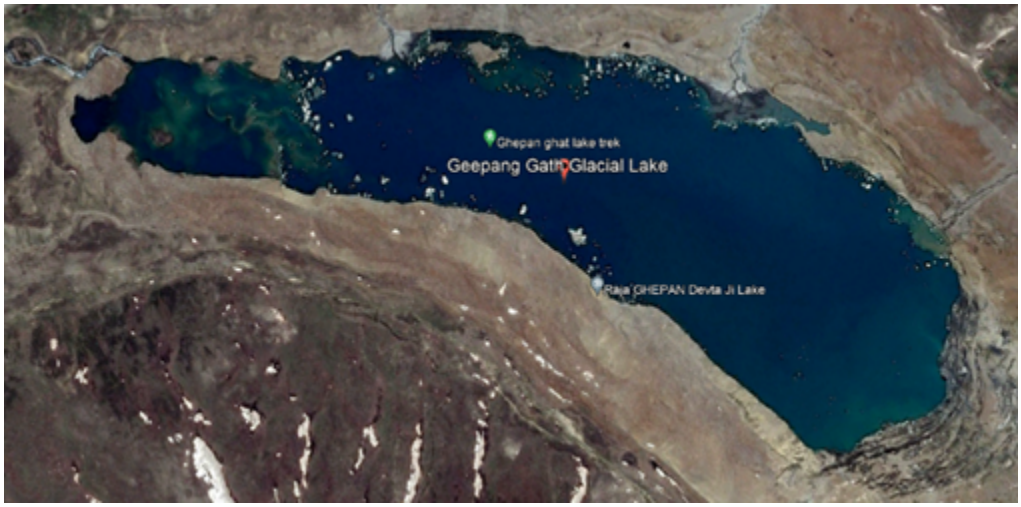


Image of gepang gath lake in 2022 downloaded from google earth

The above picture obtained from google earth pro clearly shows the lake expansion between 2010 to 2020

The area of the lake has changed from 184728 m2 in 1973 to about 865977 m2 in 2018

It is abundantly obvious from the aforementioned findings that supraglacial lake generation and lake expansion rates have both greatly accelerated in recent years.

An increase in the area of lakes leads to many disasters because the water level rises significantly

Glacial lakes are being formed, growing, and erupting due to the rapid retreat and thinning of glaciers, which impacts water resources, runoff regimes, and hydrological processes.

When the glacier melts there will be a significant rise in water levels, which leads to an outburst of glacial lake and this may lead to loss of terrestrial lives. Mercury that has been stored in ice is

released as glaciers melt, harming downstream ecosystems and the atmosphere which increases the toxicity levels in the earth.

continuous increase of meltwater due to glacier recession may create depressions and deep basins in the bed allowing space for the lake to grow and develop

glacial lake outburst floods which occur due to an increase in water levels as the glacier melts and cause damage to the downstream settlements, communities, end the life of many habitats,animals living around this area.

Hence melting of glaciers and lake expansion is to be considered a serious issue and also steps to be taken to control the overflow of water and also continuous monitoring of these glaciers is to be done from time to time.

As climate change(global warming)was found to be a major cause of glacier recession taking the steps to control global warming reduces the effect of glacier recession on the environment

Methodology

The project is done by using satellite images of high and medium resolution, the raster images that we have are from USGS .And also the shapefiles of the lake in different time periods shown above are from USGS and QGIS.
Climate parameters are done from NASA Power data.

1)Getting raster images from USGS

The process begins in usgs, in which the lake (Gepang Gath lake) to be pointed using the coordinates or using search bar.The lake will be displayed on the screen.We need to select the coordinates in such a way that the coordinates covers the entire area of lake. After this cloud cover should be reduced to a decent level that is around 15-20%.Then go to the Data Sets tool and select the landsat satellite based on the time interval in which we need the raster images.Then download the natural color images.Export the images.

The downloaded raster images need to be imported to QGIS to get images with different bands, with clear visibility of the lake.The bands should be changed accordingly from the properties to get the clear image.

2)Making shape files.

Firstly the boundary of the lake at different time intervals are marked in the Google Earth Pro to know the outer shape of the lake which copies the coordinates of that place and fits to the raster image at its coordinates when clubbed. The boundary lines of each time period need to be exported to QGIS in which it is fit with a respected raster image and the extra part other than lake should be discarded to get the exact shapefile.In the same process shape files of other time periods to be done.

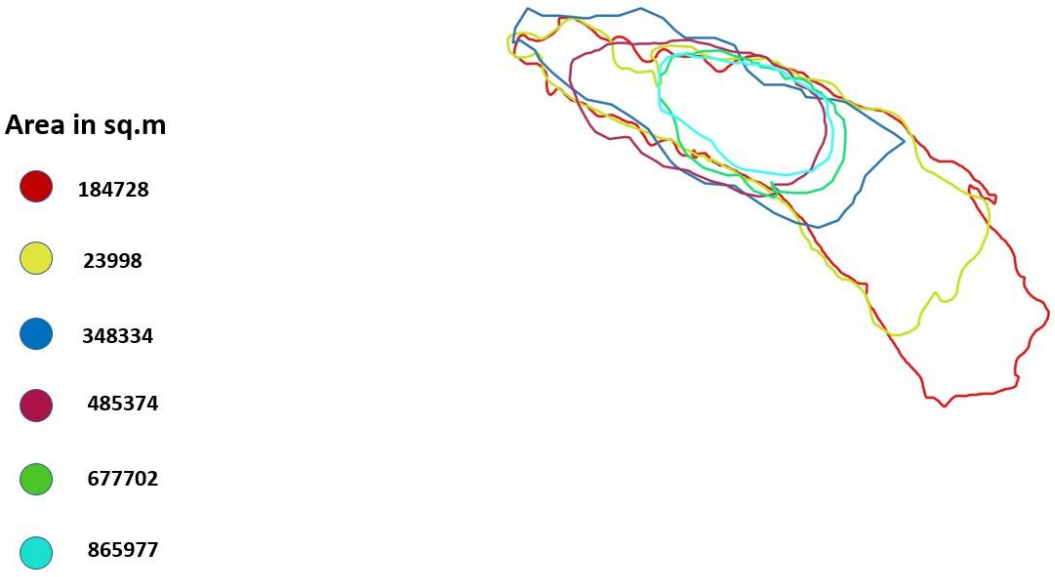
And also the area of the shapefile can be found in the QGIS from the field calculator, the area is in square meters as shown above.The area is increasing year by year due to climate change like temperature,precipitation and relative humidity.The change is shown in the graphs.

3)Climate data

The Climate data as shown got from NASA Power Data. We need to give the coordinates of our interested area in the power single point option.Also we need to select the time interval in which we want climate data like precipitation, Relative Humidity, Temperature and made them into CSV files which will open in the excel sheet so that we can plot the graphs we need.

Results and discussion

We have made the shape files of the lake from 1970 to present.We used raster images which are used to find shapefiles in QGIS and also found the area of the lake in different time periods.We observed that the area of the lake is increasing day by day. The area of lake at different time periods as shown



The area of the lake is increasing due to global warming,increase of temperature . An also the climate change of lake also found. The annual variations of temperature,humidity and precipitation is found.The variations are shown in above graphs

Conclusion

The consequences of future lake area increase in gepang gath has both positive and negative effects on the surrounding ecosystem and inhabitants. These are some of the potential outcomes:

Flood Risk : One possible disadvantage of a lake area expansion is an increase in the risk of flooding in the neighboring areas. The lake's expansion increases the likelihood that it may eventually overflow its banks and cause floods downstream that might damage crops, homes, and other infrastructure.

Loss of Habitat : As the lake area expands, some of the current residents of the lake area risk losing their habitat. This could result in a decline in biodiversity and long-term consequences for the environment.

Water Availabilty : On the positive side, increasing the lake area would increase the availability of water in the area, which would be beneficial for human endeavors like agriculture.

Tourism: The Gepang Gath Lake is surrounded by majestic glaciers and towering mountains. The surrounding countryside is spectacular, and visitors can take in the breath-taking views from the lake's shoreline. The lake's growth might help promote tourism there. The neighbourhood may profit economically from this.

Landslide risk : The extension of the lake area may also considerably increase the risk of landslides in the area due to the destabilization of slopes brought on by the water.

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