

CORE CONCEPT OF GLACIERS AND MELTING GLACIERS EFFECTING THE GLOBAL ENVIRONMENT

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ABSTRACT

Glaciers and ice sheets are found almost in every continent of the world for more than thirty million years and are the large persistent body of perennial accumulation of dense crystalline snow and ice that exist intermittently over a period of time in Polar Regions and in the mountain ranges of landforms. Glaciers are constantly moving and melting because of internal and external pressure and gravity under its own weight. Although extensive glaciers systems lies on different mountain ranges of the landforms in the world i.e. more than seven thousand glaciers lies in Africa, Andes, Alaska, Canada, Greenland, Eurasia, European Alps, New Zealand, Nepal, Norway, Pakistan, South America and in North America Continent. In the mountain landforms, Pakistan has more glacial ice in the Himalayan Range, Karakorum Range and Koh-Hindu-Kush Range. Glaciers also exist in southern hemisphere in Antarctic Region, in Northern Hemisphere in Arctic Region, Greenland and remaining occurs in the landforms of mountain regions. Glaciers exhibit the different wave like motions that mostly occur internally thus resulting the glacier surge, and waves of velocity. When the glaciers and ice sheet gains a large eroded material through the accumulation of snow above the equilibrium line, the glacier mass is lost through the ablation process and melting water runoff towards the down slope at lowest elevations below the equilibrium line that results the formation of accumulation area, alluvial fan stratification, alluvial plans, arête, askers, braided streams, cirques, crevasses, drumlins, fjords, fracture zones, glacial valleys, ice aprons, and ice bergs. Glaciers are among the oldest and coldest ecosystems on earth that together support the psychrophilic taxa and also impart a requisite water source to shape the downstream ecosystems. But due to global warming and rapid rise in the tropical climate change, melting of tropical glaciers, the fast ablation has contributed the shrinking of global glaciers thus causing the major biological, environmental and human consequences. Subsequently, mountain erosion results the transportation of debris, silt up, floods, and land sliding, raised the global environmental issues. The study includes the core concept of glaciers and melting glaciers effecting the global environments.

Keywords: Askers, Craves, Drum line, Fjord, foliations, Gouge, Ice bergs.

INTRODUCTION

Glaciers are the blessing of nature which are constantly melting and moving slowly in the oceans and towards the land. In the recent past, the world glaciers have been affected due to global warming and have caused the significant environmental issues. Primarily glaciers fall into two groups i.e. Alpine glaciers in the mountain, valley or land glaciers and polar glaciers and ice sheets that exist in the Polar Regions. ("Ice, Snow, and Glaciers and the Water Cycle". www.usgs.gov) Glaciers are often called rivers of ice. In this article, the theoretical framework involves concept, defining terms of glaciers; effects of melting glaciers affected the global environment. Significance of the research, statement of the problem and research questions by using both qualitative and quantitative research methods, primary and secondary sources, will be used for comprehensive data collections. The aims and objective of the study is to highlight the core concept of glaciers and melting glaciers effecting the global environment. The study will also analyze and examine the potential impact of melting glaciers due global increase temperature, resulting frequent hurricanes, tornadoes, typhoons, increase avalanches, eroding mountains and floods, cutting of the rivers banks thus affecting the environment, local demographic

feature and world hydrology. The main purpose of this study is to describe that what is prevalent with respect to the issue or problem under study.

The article has been constructed with following research questions.

- What is the core concept of glaciers?
- How the glaciers are formed?
- How many are the types of glaciers?
- How melting glaciers effecting the global environments?

REVIEW OF LITERATURE

Benson C.S, describes in his book titled, “Stratigraphic studies in the snow and firn of the Greenland Ice Sheet”, that glaciers are the largest frozen ice reservoirs of fresh water on the Earth that holds about 69% of ice sheet with significant accumulation of the water in the world and categories the two different types of glaciers exist on Earth, Polar Glacier and Land glaciers.

Bennett M. R and Glasser N.F, has explained in their book titled “Ice Sheets and Landforms”, that glaciers are a huge mass or persistent body of dense perennial ice that are consistently moving slowly by the crystallization of snow or other forms of solid precipitation under its own weight over land is called a glacier.

Craig Tim, explained in his book titled, “Pakistan has more glaciers than almost anywhere on Earth”. Pakistan has the world largest glaciers in the world.

Walley Robert, discusses about the glaciers in his book titled; “Introduction to Physical Geography”, where he has very clearly described that the glaciers are formed when the accumulation of snow exceeds its ablation over millions of years during Ice Age.

The research work will be significant for the students of Pakistan’s Study at BS, M Phil and PhD level. It will open new avenues and opportunities for the researchers to conduct their research on the same field.

1. The core concept of glaciers

Glacier in Latin language is called “glaciarium” which means “Ice” (Simpson, D.P, 1979). These were formed when the accumulation of snow exceeded its ablation in Pleistocene Age. When the Ice Sheet reached its highest size about 20, 0000 years ago and beyond, the glaciers spread, featured, carved, processed and altered the Earth’s surface thus creating many landscapes and ice sheets that exist even today in the Northern and Southern Hemisphere. In the Polar Region, 99% glacial ice is contained and provides global strategic reservoirs that is 69% of the world fresh water on earth. The consistent glacial striation has affected the global climate change e.g. the increased Co₂, cloud cover, glacial mass changes, means temperature and precipitation are the sole indicators of rise in global temperature. (Staff, June 9, 2020)

Presently, glaciers existed in the Arctic and Antarctic Regions, Greenland, and outside the Polar Region within the mountain ranges (Staff, June 9, 2020). The glacial ice sheets are found in every continent but the world largest land glaciers exist in Pakistan’s mountain regions and small size of glaciers also exist in the different parts of the world as well. (Walley Robert, 1992) According to the various studies, Pakistan’s Mountain Glaciers system consists of 7,253 large and small sizes of glaciers and tributaries in Himalayan Range, Karakoram Range and 543 small glaciers in Chitral Valley in Koh Hindu Kush Range which constitute 13% Area of Pakistan covered with glaciers that are of 13680 sq km out of Pakistan’s total 881,913 sq km geography. (Craig, Tim, 2016)

The glaciers in Pakistan also provides the biggest land ice mass which are found more on the Earth outside the Polar Regions and feed tributaries, rivers and contribute 75% storage water supply for hydroelectricity, irrigation purpose, domestic use and for plantations. (Sheila Mysorekar, 2017) The glacial mass on Earth has been significantly affected by the long term climatic change .e.g. increased rise in the Sea level, mean temperature, precipitation, cloud cover, coastal erosion and the mountains erosion. These are the probable indicators of glaciations on Earth surface. (Ice, Snow, and Glaciers and the Water Cycle. www. usgs.gov). The core concept related to glaciers will be highlighted in this study.

a. Structure and formation of glaciers

Glacier’s structure and formation is the result of continuous snow fall on the Polar Regions and on mountain landforms but when exceeds, the ablation starts and cirques are formed that denotes the head of a glacier. It is also called the corrie. As the ice melts, gradually and progressively, it moves towards the downhill, once melted and it forms the bowl shaped lake in the basis of cirque. The glacier from where it originates, called glacier head and from where it terminates, called terminus, snout or glacier

foot (Benson, C.S., 1991). When the solid and compact snow gets thicker due to extreme cooled temperature, the ice sheet turns into distinctive colorful tint. (Webexhibits.org)

b. Motion and speed of glaciers

Glaciers always move and flow towards the downhill because of internal mass pressure or seismic reaction that causes glacier's motion and speed. When the ice is melted under high pressure from frictional heating, the water is created and that water becomes the source of glaciers movement as well. (W.S.B. Paterson, Physics of ice) In certain cases; the speed of glacier varies from 1m (3ft) to 20m-30m (70-100ft) per day depending upon the factors, such as snowfall, ice thickness, slope, melt water production, basal temperature, bed hardness and longitudinal confinement. Few glaciers move very rapidly which is called surge, depending upon glacier exhibit normal displacement until suddenly they accelerate due to increased temperature and they return to previous movement state. (T. Strozzi et al)

The glaciers are moving constantly because of internal and external pressure but the glacier mass and the melting water at the bottom of glacier causes deformation, gliding and gradual flow of the glaciers over the landscape. (Iken and Bindshadler, 1986) When the glaciers move slowly towards down slope, bulldoze the rocks, plucked rocks materials from the bottom, astride the glacier and move downhill with glacier ice, transport debris, moraines, and unconsolidated material from one place to another place. As the glacier surface melting generates water and that melted water moves slowly through the glaciers to its base and consistently regulates ablations, they move downhill and transport debris. However, glacier's motion and speed can be categorized in following three ways;

- i. Creep, internal deformation.
- ii. Basal glacier.
- iii. Soft bed sub glacial deformation. (Smith, 2006)

c. Classification of glaciers.

Glaciers can be classified by its size, shape, behavior or by thermal state keeping in view the thermal characteristics and morphology. Land glaciers usually formed on mountain crust, slope and valley. Glaciers on landforms are called the ice field or ice cap and valley glaciers (Nichols.edu). The glaciers larger than 40,000 km² are called the continental glaciers or ice sheet and these glaciers are found in Polar Regions. (Department of Geography and Geology, University of Wisconsin, 2015) Thermal state of temperate glaciers remains melting as well. The polar glaciers remains below freezing temperature from its base to surface but the land snow surface depends upon the temperature and seasonal melting. The thermal state of sub polar glacier depends upon its make and type. (Lorrain, Reginald D.; Fitzsimons, Sean J, 2017)

However the glaciers are classified as under;

i. Continental glaciers

Continental glacier in geological term is a continuous glacial masses of ice that much larger than the land glaciers. The big glaciers are called the continental glaciers and ice sheet. The small continental glaciers are called the ice field. Arctic, Antarctic and Greenland glaciers are mostly up to 11500 ft thick. (Bennett, M. R.; Glasser, N. F, 1996)

ii. Landforms glaciers

These glaciers lie in the landforms of high up in the mountain regions and due to the continental glaciations these are typically constrained by mountainous terrain features on all its side. Alpine glaciers are also found across the globe, almost in every continent except Australia; Alpine glaciers are also called the cirque and the mountain glaciers. Furtwangler glacier in Tanzania, Gorner glacier in Switzerland, Himalayan glacier and Karakorum glaciers in Pakistan and Ural glaciers of Eurasia are the best example of Alpine glaciers in the world. (Knut, Peter G, 1999) These are formed in the mountainous area when continuous snow fall remains round the years and are also called the Sub-Polar Glacier, temperate glaciers, and valley glaciers. These glaciers are mostly found in rocky mountain of Himalayan Range and Karakorum Range in Pakistan, Alps, Andes, Caucasus, and in Scandinavian mountains. (Edward R (2000) World largest Mountain glacial ice exist in Karakorum Range in Pakistan and small size of glaciers also exist in the different parts of Australia, East Africa, Eurasia, Mexico, New Guinea and in New Zealand. (Staff, June 9, 2020).

iii. ***Polar glaciers***

Polar glaciers are called the poly-thermal glaciers lies in the Frigid Zone. Polar glaciers exist in Alaska, Canada and in Greenland Polar glaciers are formed due to the continuous snowfall in the Polar Region. (Victor Paul-Emile, 1994)

iv. ***Temperate glaciers***

These are formed when the liquid water coexists with glacier ice and they are also called the isothermal glaciers. A glacier in which liquid water coexists with frozen water (glacier ice) during part or round of the year is called the temperate glaciers which are mostly found in Africa, Alaska, Antarctic Peninsula, Asia, Coast Mountains, Europe, Greenland, New Zealand, North America and South America. (W.S.B Paterson, 1994)

v. ***Valley glaciers***

Valley glaciers are also called the glacial trough, they usually originates from the plateau ice-cap or from a cirque at a stream valley head that has been glaciated over a period of time and flow downwards and spread out in between valley walls. They typically formed the centenary; cross section and V-shape valley and provide a little frictional resistance to the slow moving glaciers. (Department of Geography, Central Michigan University). V-shaped valley occurs almost in many parts of the world and is characterized by the features of the mountains. (Monk House, F. J, 1971)

Melting glaciers effecting the global environment.

Since the glaciers are the major reservoirs of fresh water that generally persist through the summer. The causes of glaciations are the global warming, increase of solar radiations, emissions, rise in the seasonal temperature and changes in the ocean currents. The continental melting of glaciers contributes the water to the ecosystem round the years but frequent melting of glaciers has affected the animals, ecosystem, plants, coastal erosion of lands and rise in the oceans and sea level because of high rise of global temperature that resulted the frequent storm surge, tornadoes, hurricanes and typhoons. The situation is expected to be more worsened because the temperatures in mountainous areas and Polar Regions are frequently rising as compared to the global average. If the concrete measures are not taken by the collective global community, then we may lose two-thirds of our existing glaciers as told by David Molden, the director general of the International Center for Integrated Mountain Development. He further said that if warming is limited to 1.5 degrees Celsius (2.7 degrees Fahrenheit) above preindustrial levels, the mountains will lose even more than third ice, largely held in glaciers and by 2050, it may decreased to less and less water for the global community. Craig, Tim, 2016). Although Pakistan has a little contribution in global greenhouse gas emissions, it contributes even less than 1% as said by Federal Minister of Climate Change Malik Amin Aslam. In this regards, and due to the global effects on glaciers, the impact will be more swear for down streamers because of melting glaciers feeds the down streams valleys and Indus River Basins which is Pakistan's main water source for over a 2200 million people as it terminates into the Arabian Sea.

CONCLUSIONS

The glaciers and the polar ice sheet's increased melting, that always terminate into the oceans and in case of land glaciers, it terminates on land. This rapid melting has contributed the heavy stream flow and subsurface recharge that have caused the earth erosion. In the contemporary global environment, the polar glaciers, non-polar glaciers, ice sheets, ice caps are now a day's very much sensitive to climate change, this rapid changes has significantly contributed to the high rise in the global temperature, rise of the oceans and sea level change. Glaciers has gained mass by accumulating snow, and lose mass (ablation) by melting at the surface or base. Net accumulation occurs at higher altitude and, net ablation occurs at low level altitude. However the regular mass balance record also revealed the continuous changes in the glaciers ablations as a function of climate change. Since the glaciers and ice sheets represent the largest reservoirs of freshwater on the planet therefore must be well protected and make the suitable environment for our future generation. Snow hydrology is an active area of study, and is also significant with respect to the impacts of climate change on water resources and the seasonal timing of stream flow. Since Pakistan possess the largest mountain glaciers in the world that provides 75% water and make the strategic strength for her riparian potentials, hydroelectricity, irrigation system, plantations and for domestic use. World high altitude regions and Pakistan's high altitude regions are undergoing rapid and considerable change due to climate change. Over a period of time there is a significant increase in melting of Pakistan's glaciers, causing trouble in the relevant fields.

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