*International Research Journal of Environment Sciences*_____ E-ISSN 2319–1414
Vol. **5(7),** 70-74, July **(2016)** *Int. Res. J. Environment Sci.*

Review Paper

Global Warming Effects on Water Resources: An Overview

Sinha Aparna, Gupta Arnav and Kumar Sanjeev*
Civil Engg. Deptt., GEU, Dehradun, UK, India
er.sanjeevkr@gmail.com

Available online at: www.isca.in, www.isca.me
Received 9th April 2016, revised 4th June 2016, accepted 10th July 2016

Abstract

Water resources are highly responsive to climate variation in all time and space scales. During the last century, the global runoff is increased by about 3%. The amount of various greenhouse gases has been enlarging over the time. The accumulation of greenhouse gases is causing increase in global warming effects. After 1950, a number of ascertained alterations are new over tenner to millennium[1] .The ill-effects on nature can be observed as ocean and atmosphere are getting warmer, the quantity of ice and snow are melting and the sea level is raised up. From the last 30 years there has been consecutively heater atmosphere in the Earth's surface with respect to any decade since 1850. In northern hemisphere the 30 year duration between 1983-2012 was found to be the most heater period. Over the period 1880-2012, a warming of about 0.85[0.65-1.06] °C in temperature data of land and ocean surface averaged globally is calculated. It is the complete extent of scientific practices all together, like meteorology, geology and oceanography, but no one knows the real effects for specified parts in the world. Even every scientist agrees global warming will have plenty ill effects on earth and i.e. on the climate and water resources.

Keywords: Global warming, Water recourses, Climate change, Temperature.

Introduction

Since from the mid-20th century, the global calefaction is rising in terms of mean temperature of world closer to aerofoil air and oceans. From the fifth appraisal report by IPCC(2014)[1] (Intergovernmental Panel on Climate Change), on a world wide scale the ocean calefaction is highest around the aerofoil, and the top most 75 meter are heated by 0.11°C every decade during the year 1971 to 2010. In the mid of the 20th century the temperature has been increased due to increment in the amount of greenhouse gases, which are caused from the man action like combustion of the fossil fuel and disforestation[2]. The latest IPCC report suggest that the world wide aerofoil temperature are approximately rising further 2.0 to 11.5° F (1.1 to 6.4 °C). Increment in worldwide temperature will result in rise in sea levels and alter the quantity and the model of precipitation[3]. Global calefaction is probably to be the highest happening in the Arctic region. It is linked up with continued depletion of sea ice, land ice and glaciers. The average temperature of our atmosphere has increased more than 1°F since 1900 and is still increasing[4].

Global calefaction is mainly a problem of excessive CO_2 in the atmosphere which acts like a cover or blanket, trapping heat and ultimately warming whole planet. This is not all, still the problem overloads, as we burn fossil fuels like oil, charcoal and natural gases, deforestation and burn forests for human needs accumulating carbon. Even some waste and agricultural management practices worsen the climate by releasing other strong global warming gases like CH_2 and N_2O [5].

Effects of Global Warming on Water Resources

Global weather alteration and Precipitation: The pattern of weather alteration (GCMs) predicts that U.S. annual mean temperature to ascend by 2 degree Celsius to 3 degree Celsius over the succeeding decade, with higher increase in north areas up to 5°C, and northern Alaska up to 10°C. Precipitation in the U.S. that was gained by 5% to 10% till 20th century and still there is prevision to carry on to be increasing all over. Despite of increasing precipitation in various regions, there is decreased in accessibility of water that are predicted in some areas, because of gain in evaporation. The 20% reduce in summer precipitation that is projected for southwestern regions, and a general decrease for southern areas[6].

Global Climate Change and Water Resources: Increase in evaporation loss is likely to abbreviate the supply of water in various places. The sterling insufficiencies are likely to take place in the summertime, which will cause in decreased soil moisture levels further leading to agricultural drought. This is evidenced by an extended drought in a southern and western United States, which was calculated to range up to 6 billion dollar in harm to the municipal and agricultural society[6].

Rising of sea levels also decreases groundwater quality via saltwater intrusion. Thus there will be radical changes to the

hydrology of coastal areas. Recent prevision of rising of sea-level by the end of the 21st century lies in between 19 to 58 cm[6].

Lakes and Rivers: Since 1960s, surface water temperatures of lakes and rivers in Europe, Northern America and Asia have been warmed by 0.2 and 2.0°C. Also the deep-water temperatures in the large Eastern African lakes (Victoria, Kivu, Albert, Edward, Malawi and Tanganyika) have heated upto a temperature of 0.2 degree Celsius and 0.7 degree Celsius. Increase in the temperature of water regulate the thermal configuration and internal hydrokinetics of lakes and rivers that results in increasing evaporative water expiration and summer configuration happens sooner in the weather.

Recently, no worldwide ordered drift in level of lakes has been established. But in Mongolia and China (Xinjiang) some lake levels have arisen as a result to increment in ice and snow, while the levels of lake in Australia, China (Qinghai), North America (North Dakota), Europe (central Italy) and Africa (Zimbabwe, Zambia and Malawi), due to the joint outcome of human activities, warming and drought the lake are declined[7].

Changes in surface and groundwater systems: Some areas are very strongly determined by the variation in river flows. NAO, ENSO and other various systems which are used to ascertain the large-scale atmospheric circulation patterns that function at under-tenner and multi-tenner time-descales. At the world wide measure, there were grounds of a wide consistent design of alteration in yearly runoff, with specified areas go through an increment, especially in the above latitudes, and others a decrement, for example in areas of southern Europe, West Africa and southerly Latin America. During the 20th century they claimed that in every 1 degree Celsius increase in temperature; the global total runoff is increased by 4%, with regional fluctuation around this drift, but this has been biased because of the little count of information period and gainsay because of the issue of non-weather drivers on overspill. Because of the consequences of the elevated CO_2 immersion on plant physiology, the CO_2 forcing leads to increment in runoff[3].

Over the last few decades the groundwater levels of various aquifers around the world are reducing, but the groundwater recharge rates are exceeding and this is due to groundwater pumping. There are some areas, like south-western Australia, where not only by increase in water demand increases the groundwater withdrawals but also due to decrement of weather in reload from aerofoil water supply. Near Canada and Winnipeg the shoal well hydrographs appear to have no obvious trends in the upper carbonate aquifer, but it displays variant of 3 years to 4 years mutually related with alteration in yearly precipitation and temperature[3].

Ocean Chemistry and Temperature: The process of converting ocean into acid due to climate change impairs the ability of shelled organisms and coral reefs to form shells and skeletons. When the oceans engulf CO_2 from the atmosphere the acidification occurs. Some enquiry appeared that the atmospheric concentration of CO_2 is reached to 400.14 ppm now, and 520 ppm is reached possibly by mid-century[7]. The ocean surface water has increased by 26% in acidity and the pH value is decreased by 0.1, deliberated as hydrogen ion concentration.

Warmer oceans increase infrastructure costs, put coastal communities at peril, imperil coral reefs and fisheries and imperil polar creatures. By chance the most alarmingly, acclivitous ocean temperatures speed up the boilers suit thawing drift. Actually the ocean has engrossed the heat about 20 times as much as the atmosphere has absorbed over the past half-century, over the coming decades some models advised that it is probable to warm the air about 0.55° Celsius worldwide. Over the period 1971 to 2010 on a global scale, the upper 75m is warmed by 0.11 °C per decade[8].

Species of salt water: As compare to freshwater and land species the marine species are more critical to visualize and are not properly studied, they go through some of the like and unlike consequences from global calefaction. Warm-water species make a motion to places formerly too cool for their endurance while Cold-water species make a motion to seek higher-latitude, deep cool waters. Lobster-shell disease is the marine diseases, which is historically thought to be too cold in water. There is a optimal growth of several coral pathogens is due to higher ocean temperatures between 30 to 35° Celsius (86°to 95° Fahrenheit).When the temperatures of seawater acclivity above the range that corals can tolerate, then there is emission of their symbiotic algae and exposing white skeletons this process is known as bleaching. The presence of carbon dioxide in oceans made the oceans more acidic. A crystal configuration of calcium carbonate which is formed by tiny organisms known as the aragonite, they become too corroded to survive in cold waters or in high-pressure considering some parts of the shoal North Pacific, the deepest waters of the ocean and the southern ocean[7].

Rain and Snow: For mounting the stage for extreme precipitation, a heater aura spurs the evaporated water from surface and sea and hence it permits the aura to grasp more moisture. For every 0.6° Celsius (1° Fahrenheit) acclivity in temperature, the atmosphere's water-holding capability is step-up by 4%. Places now which are wetter than the historical average are Easterly South and North America, Northerly and central Asia and Northerly Europe. Between 1979 and 2005 in South and North Korea and Northern Scandinavia per decade the precipitation is increases by 3-15%. Over the past 50 years, in the Northeast of U.S., the numbers of days of extreme precipitation are rises by 58%, while in the Midwest of U.S. it is rises by 27%[7].

Land Ice: The major role that acclivity the global sea-level is water from ice sheets and shrinking glaciers. Land ice in

mountains and Polar Regions, thus this excess overflow water added in freshwater into the oceans. About 17% of the global population survives close to rivers and they obtain their water needs from snow cover and glaciers. During this century many of the communities can anticipate to see their water needs at acme and then successively fall. Various rivers which obtain water from thawing glaciers and snow are probably to have earlier acme runoff in spring, thus there is an increase in overall runoff and hence, the short term risk of flash floods and rockslides is possibly increasing. For keeping the planet cool the Polar Regions ice mull over sun's energy into space (i.e. albedo). Due to this land ice shrinks thus it engulfs more sun energy and ultimately quickens the planet's warming[7].

Any form of ice that lasts remain for a year on surface are included as Land ice such as ice sheets, mountain glacier ,ice caps , frozen ground and ice fields (it is similar to but smaller than an ice sheet). In the Northern Hemisphere approx 25%of the land area is permanently frozen, with about 10 meter of thick layer[7].

Sea Ice: Decline of sea ice imperils peoples and animals living in the Arctic, acclivity the global security business and speed up the warming. Polar sea ice dethaws in every summer and regenerate in every winter. In Arctic, a freeze-thaw cycle has been dramatically changed due to global warming. After of multiple years in Arctic some of the Arctic sea ice arises to 3 meters (10 feet) thick, now after a year much of the ice have same thickness which make it much more capable to dethaw in the summer. Scientists envision that just after a few decades in summer the Arctic Ocean may be ice-free. The cascade of outcome includes: Sea level are not acclivity due to loss of sea ice though it acclivity due to loss of land ice. It is because sea ice afloat on the sea and it acts like ice pieces on water in a glass, its thawing does not cause the water to brim over[7].

Sea Level: The 40% of the world's population lives nearby coastal areas so, the higher seas peril coastal communities and threaten groundwater supplies. There are two major reasons that causes sea level to rise is First, as ocean temperatures arise, the warmer water amplify. Second, shrinking land ice, such as polar ice sheets and mountain glaciers is releasing water into the oceans. From 1870 and 2000, on an average every year the sea layer is gained by 1.7 mm, for the entire sea level acclivity of 221 mm. The value of sea layer acclivity is rising. In the year 1993,the NASA satellites has display that the sea levels is accelerating more rapidly, per year approx 3 millimeters, in between 1993 and 2009 the total sea level acclivity by 48 millimeters[9]. During the twentieth century the sea levels crept upto 20 centimeters. According to IPCC the year between the years 1901–2010, the global mean sea level acclivities by 0.19 m.

Water Use: During extreme rainfall the municipal sewer systems may get overflow, burbling untreated sewage into drinking water supplies. The accessibility of drinking water get abbreviate in downstream due to loss of mountain snowpack and due to higher temperatures the earlier spring snowmelt spurred. Drinking water supplies are threatens for millions of people due to the shrinking of mountain glaciers. The acclivity in sea-level can lead to salt water encroachment into especially in low-lying, gently sloping coastal areas and groundwater drinking supplies. The amount of water which are available for irrigating downstream is get abbreviate due to loss of mountain snowpack, while earlier spring snowmelt impacts the timing. The supply from groundwater is contaminated by invasion of saltwater. Due to lower level of lake and river it may abbreviate the capacity of ships to safely carry the cargo due to the peril of their stuck or forbid the use of large ships totally—both of which it may increase the shipping costs for food and other goods. The capability of hydroelectric plants is may threaten due to lower levels of lake and river, while in nuclear power plants and coal the water is too warm to cool it due to of higher temperature which leads to power blackout. Electricity generations are as well as threaten by the Shrinking of mountain glaciers. Decreases snowpack and earlier spring snowmelt which peril the traditional winter sports ,like skiing and snowmobiling , while it increase the costs of maintaining amateur conveniences such as pleasure boat docks and even beaches due to lower water levels in lakes and rivers[7].

Flood: The flood is caused due to vivid and long-lived precipitation, dam collapse, and snowmelt, reduced transportation because of storm or landslips or ice jams. Floods devoled on volume, precipitation vividness, form (rain/snow) , timing ,ancestor circumstance of rivers and their catchment area (e.g., comportment of soil character and status, snow and ice, existence of dykes, wetness, dams and reservoirs, urbanization, value and occurrence of ice or snow dethaw).Observed precipitation intensity and other observed climate changes are seems to increased, e.g., During winter there is an increment in the westerly climate figure all around Europe, leads to highly rainy abject pressure scheme that rarely initiate floods. Previously in the 20th century it has been concluded from The Functional Party I AR4 compact for Policymakers is that the intensity of large precipitation cases has gained over most areas and that it is highly probable to not that there has been a human part to this drift. During the last 10 years (1996–2005) the costal flood is twice as large as per decade (1950 and 1980), on other side the economic harm is gained by 5 times. In the year 1998 the flood in Bangladesh, approx 70 percent of the nation area was afloat (liken to a value of 20–25%)[3].

Droughts: Drought advert as a hydrological drought (abject flow of water and abject water layer in groundwater, lakes and river), agrarian drought (land moisture is abject), meteorological drought (precipitation well is below intermediate) and ecological drought (it is combined of all). Area where droughts have been taken place appears to be dictated largely by alteration in the atmospheric circulation, in temperature of sea aerofoil, precipitation and mostly in the tropical.

During 1970s the land surfaces were wet in the Southern Hemisphere while in the 1960s and 1990s it was relatively dry, and from 1974 to 1998 there was a dry drift, although the period from 1948 to 2002 the trends were small. Droughts affect the supply of water for the agricultural purpose, industrial purpose and as well as for the domestic purposes and it also affect rain-fed agricultural yield. Some sub-humid and semi-arid regions, e.g., western USA, the Sahel (Nicholson, 2005), Australia and southern Canada have abide from more intense and multi-annual droughts[3].

Economy: Extensive repair is mandatory in crucial infrastructure such as roads, home, railroad tracks, bridges , airport runways, dams , power lines, seawalls and levees due to floods, Sea-level rise, droughts, extreme storms, and wildfires. Austere snowstorms and rainfall events can detain planting and harvesting which cause embrangle traffic, power outages, retard air travel and it make difficult for people to go for their daily business. Climate-related health peril also abbreviates productiveness, such as when there is utmost heat they restrict construction. Social kerfuffle and Mass movements of people may lead to civil agitation, and might even acanthi military intercession and other unintended outcome. The fond accounting of these assess evoke that coping is potential to be more costly steps to abbreviate carbon emissions thereby reducing colligated climate affects[7].

Governments may also have to anatomy subways, seawalls, strengthen bridges, contain sewer overflows, and other decisive element of the transportation system. After disasters bang the reconstruction is rises even more costly than these encumbrances assess. The costs do not include those stemming from lives lost and other irreversible outcome of allowing heat-trapping gases to conglomerate unbridled in our atmosphere[7].

Impact of global warming in future

The costs of climate change with respect to water will preponderate the welfare throughout the world. One intellect is that the precipitation variance is very potential to step up, and highly patronize droughts and floods are awaited. A peril of droughts in snowmelt-fed basins in the abject-flow season will gain up. By modification in water management and acres management and by appropriate infrastructure investment the affect of flood and droughts can be treated. But an effectuation of these steps will implicate price (US Global Change Research Program, 2000). The affects of Hydrological changes can be useful for some aspects and useless for other aspects. For example, Both in-stream and out-stream water users get welfare by increasing annual runoff and by gaining the renewable water resources, but it might instantly generate impairment by the growth of flood peril. Recently, in some parts of southern South America a trend to surfactant condition has increased the area overflowing by floods, but in Pampas region of Argentina it has also improved crop yields, and it has provided new opportunities for commercial fishing. Another example, In Russia, by shallow water tables the current annual damage is appraisal to be US$5–6 billion (Kharkina, 2004) and in the future it probably increases. In accession, an increment in yearly runoff may not result to a profitable increment in readily useable water resources. Turbidity, pathogen and nutrient lading to aerofoil water source increases due to increase in precipitation intensity. One of main citrons that mold futurity water stress; social as well as economic, demographic and technological changes in climate change and it possibly play more significant part in most regions and at most time purview. It should be illustrious that, the climate alteration would seem to abbreviate boiler suit water stress at worldwide by using the per capita water availability indicator. Due to this in the densely populated part of the earth, especially in south-eastern and eastern Asia, the increase in runoff is concentrated heavily. Occasionally population increment has a smaller affect than the income growth due to increment of water stress and water use. Water stress is modeled to reduce by the year 2050s over 20% to 29% of the world acreage and step up over 62% to 76% of the world acreage. The main grounds of declining water stress is higher accessibility of water ascribable to gain in precipitation , while main grounds of increment in water stress is due to increase in water back down . For water supply sector, climate alteration extend to additional price, e.g., infrastructure of water supply get affected due to modification in water layer, which may halter the annex of supply of water use to more mass. It results, in sequence to accomplish costs and to higher socio-economic affect. And hence, the climate change preponderance of water stress has also risen in some areas. For example, The Rhine might abide due to a diminution of summer abject flows of 5% to 12% by the year 2050s, which will badly impact the supply of water and especially for thermal power industries[3].

Action taken to reduce the global warming effects

By purchasing reusable materials we can reduce the waste. Buy less packed products, so that to throw less away. Tons of CO_2 can be saved annually from being acquaintance into the atmosphere by recycling half of our household waste. The heating costs can be reduce by more than a 1/4 by adding insulation into our walls and garret as it abbreviate the quantity of energy needed to cool and heat our houses. If thermostat is decline by simply 2 degrees we can economize approx 2 thousand of CO_2 annually. Compact fluorescent light (CFL) bulbs should be used in place of standard light bulbs. By using CFL instead of just one electric light bulb of 60 watt, it can save up over £15 over the life span of the bulb. CFLs required two-thirds less energy and releases 70% of heat and net 10 times longer. If every family in UK will use CFLs then it can obviate the greenhouse gasses upto 30 billion tons which is equal to taking 7.5 million cars turned on route. Less driving reduces emanation in the air. Tires should be properly hyperbolic– this can improve the mileage of car by more than 3%. Petrol not only helps to reduce carbon emissions but also help in saving money. Car that offers good mileage should be selected. CFLs requires less energy and are intentional to cater more natural

looking light as that of a candent light bulb. Excess packed product should be avoided, especially moulded plastic and the plastic that can't be recycled. Household waste should be reduced to 10% which can save approx 0.5 ton of CO_2 which releases in the air. To save energy the hot water tank is to be fixed for 50 degrees of temperature. By using abject flow shower heads we can economies water and also abbreviate the CO_2 presence. A tree can engulf a ton of CO_2 through its lifespan. Plants and trees engulf CO_2 and release Oxygen by the photosynthesis process. On Earth they are a substantial component of the natural atmospheric exchange cycle. CO_2 is also increasing due too few trees and plants[10].

Conclusion

The global warming effect on water resources is already being seen around the world. Even though efforts on behalf of some countries to reduce the global warming effect, such as the Kyoto treaty[11], the world as a whole is pushing itself into the situations, from where the safe returning is not possible. Countries like Norway and Holland are meeting their goals to reduce emissions, but this is small fry when countries such as China and India are pumping out more and more CO_2 every year. Reducing our carbon and greenhouse gas emissions will make our personal living space more sustainable. We humankind have the ability to destroy the planet, we can also help protect and sustain it with the help of strong determination and taking the necessary action to reduce the global warming effects[4].

References

1. Pachauri R.K. and Meyer L.A. (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, 151.

2. Novaky B. (2013). Effect of Global Warming on Water Resource and Supplies. Encyclopedia of Life Support Systems (EOLSS) Climate Change, Human Systems and Policy-1.

3. Field C.B., Barros V.R., Dokken D.J., Mach K.J., Mastrandrea M.D., Bilir T.E., Chatterjee M., Ebi K.L., Estrada Y.O., Genova R.C., Girma B., Kissel E.S., Levy A.N., MacCracken S., Mastrandrea P.R. and White L.L. (2014). Linking climate change and water resources: impacts and responses. Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Section 3, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 33-52.

4. Kumar S., Himanshu S.K. and Gupta K.K. (2012). Effect of Global Warming on Mankind - A Review. *International Research Journal of Environment Sciences*, 1(4), 56-59.

5. Wikipedia (2015). Climate change mitigation. https://en.wikipedia.org/wiki/Climate_change_mitigation.

6. Richard M. Adams and Dannele E Peck (2008). Effects of climate change on water resource. Choices, The magazine of food, farm, and resource issues, http://www.climatehotmap.org/, 23(1), 12-14**.**

7. Union of Concerned Scientists, (2011). Global Warming Effects around the World. National Headquarters 2 Brattle Square, Cambridge, MA 02138-3780.

8. Edenhofer O., R. Pichs-Madruga Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. kemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J. C. Minx (2014). Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [IPCC], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1251–1274.

9. Hansen J., Ruedy R., Sato M. and Lo, K. (2010). Global Surface Temperature Change. *Rev. Geophys.*, 48, RG4004, doi: 10.1029/2010RG000345.

10. GRACE Communications Foundation, (2015). The Impact of Climate Change on Water Resources. http://www.gracelinks.org/2380/the-impact-of-climate-change-on-water-resources, 215 Lexington Avenue, New York, NY 10016, United States.

11. United Nations Framework Convention on Climate Change, (1998). Status of ratification [Electronic resource]. Kyoto Protocol: Status of Ratification, http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php.