

## Causes, Effects and Impact of Sea Level Rise

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Sea level has been reported to rise. This discovery is expected to have severe ramifications. It is therefore important to understand the concept of sea level rise, its causes and the suggested steps that must be timely taken up. These concepts will be discussed from holistic perspective covering different dimensions.

*Keywords:* Sea Level Rise, IPCC, Melting glaciers

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### INTRODUCTION

The rise in global temperature is bringing some visible negative impacts to the environmental ecology (Nicholls & Cazenave, 2010). Sea level rise is one such impact which is the subject matter of this research. It refers to a phenomenon wherein the mean oceanic level of an open water body increases over a reference period and retains that increased level for a considerable period of time. As per the geomorphic cycle of Earth, the sea level is bound to rise, however the pace of its increase has been heightening due to anthropogenic reasons (Yasuhara et al., 2006). For instance, the sea level rise has been observed to be around 180 – 200 nm since 1900 (Komine & Duc, 2011). Sea level has been observed to be increased due to several factors and global warming is a significant factor amongst them. Global warming entails rise in the mean global

temperature. Realizing the relevance and importance of limiting the rise in world temperature, the historic Paris Agreement was signed which invites dedicated attention to limit the rise in temperature to 2<sup>0</sup> C in the current century while voluntary aiming at restricting the rise in temperature to 1.5<sup>0</sup> C (Minar et al., 2011). However, even this extremely challenging ambitious target will not be able to limit Sea Level Rise to 9 mm by the end of the current century from 4 mm.

### RESEARCH OBJECTIVES

The objective is to understand the concept of Sea Level Rise. This understanding shall entail deliberating the causes of Sea Level Rise, its impacts and what should be the future steps in controlling the same. The objective is to be as comprehensive as possible, so that the readers can gain maximum information about this concept and the innovative solutions

proposed by the researcher which may be pondered upon by policy makers, environment activists, international organizations etc. This ambitious research is expected to yield positive results which will be valid for a long period of time benefiting a lot of readers over a long horizon. The objective of the research is to benefit readers from across the continents.

### **RESEARCH ANALYSIS**

Sea level is rising at a fast pace (Hashimoto et al., 2005). It was important for the research to identify the possible causes for the same. It was found that thermal expansion is a major contributor to sea level increase. Thermal expansion involves expansion of water due to applied heat effect. To explain further, this is an established fact that as water is heated, it expands (SCOR, 1991). The same phenomenon applies to the sea water wherein the heat is applied in the form of solar insolation, atmospheric heat and carbon emissions which are sequestered by the sea. These involve increase in water temperature which consequently expands the water base. Warm oceans tend to occupy higher space as compared to cold oceans. Thermal expansion is considered to be a severe cause for sea level rise. It was researched that about 50% of the sea rise in the past 25 years had been attributed due to thermal expansion (Oouchi et al., 2006). The

second cause for the rising sea levels is due to the rising rate of melting glaciers. With global warming and the presence of longer summers, glaciers tend to lose ice at a faster pace (Meehl et al., 2007). This run off adds up to the sea's mean water level ultimately altering the run off-evaporation balance (World Glacier Monitoring Service, 2018). This involves adding more water to the water body than it could lose due to evaporation leading to an overall rise in the water level. The research found the third cause to be the heavy release of Antarctica and Greenland ice sheets (Maruyama & Mimura, 2011). Around two thirds of the worlds sea level rise potential lie in Antarctica and Greenland ice sheets (Svendsen et al., 2013). However, now there has been a heavy loss of these ice sheets due to global warming, mixing of warm water, sea water, warm and cold ocean currents (Rohling et al., 2009). Fourth factor is the alteration of the use of freshwater resources available to humanity. There has been massive increase in groundwater extraction, river diversions, dam building activity etc. (Gornitz, 2001). There have been geoengineering projects altering the natural ecology. This affects rainfall pattern and climate variability which affects the overall environment. The oceans constitute 97% of the Earth's water availability, 22% makes it to groundwater and it is just 1% which is the fresh water (Church et al., 2011). With

significant alterations being made, this 1% will exhaust leading to absolute elimination of the freshwater inviting a catastrophe. Fifthly, there are natural causes which are a part of Earth's cycle. These include the impacts of El Nino, La Nina, landslides, earthquakes, tides, storms etc (Robinson et al., 2012). After identifying the causes of the rising sea level, it is pertinent to assess the impact of these rise on nature and environment. The first major impact is the habitat loss for the marine as well terrestrial organisms. While the marine ecology will be damaged resulting in the death of millions of aquatic species, the coastal habitats will also be immensely affected. This may even lead to entire island submergence. Severe impact has been already seen over Maldives and Indonesia (Ishii & Kimoto, 2009). Secondly, the economy will be trembled up. Dominant impact will be seen over coastal fisheries as well. The emerging science of aquaculture and hydroponics may be dented (Peltier, 2009). The research identified that by the end of the present century, around 4% of the population will be affected along with 0.6% of the terrestrial area (Peltier, 2009). In case of island submergence, the small island nations will be tremendously impacted. It may involve a wipe out of entire livelihood in terms of economy, settlement, infrastructure, agriculture etc. It converts into tremendous difficulties for the people who seek

refugee shelter in other nations. While some countries do have refugee friendly policies, but the overall atmosphere at present is not conducive to seek refugee status. To illustrate, it is the United Nations Refugee Convention which governs the refugee movement at the international level, however it is not mandatory for a nation to join this convention (Rahmstorf, 2007). Sea level rise has become a contributor to high level tides often converting into storm surges. These leave a circular impact upon the overall hydrology and ecology (Levitus et al., 2012). It was observed that higher storm surges act as a conducive factor for hurricanes and tropical cyclones. These become natural hazards and often affect millions of lives. Tsunami can also be a possible effect. These disasters affect the natural and the human made infrastructures negatively, often resulting in excluding the people from basic amenities. Internet supplies get disconnected, electricity gets cut off, there is no access to clean water, diseases take a toll, it is immensely difficult to connect a connection with the outside world for help (Ray & Douglas, 2011). Medical treatment cannot be reached timely. The rising territorial extents will lead to more maritime disputes as different nation states will have conflicting contiguous zones. The United Nations Convention on the Law of the Seas, defines the maritime extent in terms of extension of the

maritime boundaries from the baseline (Lombard et al., 2009). Since the territorial extent is shrinking and the maritime boundary is advancing a situation of conflicting maritime boundaries can arise which will not be easy to resolve amicably (Cooper et al., 2002). It can result in a globalized version what the world has been experiencing for decades in the South China Sea, wherein different countries have conflicting claims over the South China Sea and are unable to reach an amicable settlement (Svendsen, 2013). The same situation happened in case of Caspian Sea however the littoral states were able to reach up to an agreement and share the benefits mutually (Woodworth & Player, 2003). Such agreements are rare in world history and the disputes are bound to result in global instability which is not suitable in anyone's interests.

The research tried to postulate certain solutions that can be taken up to solve the crisis of sea level rise. The foremost solution is the preparation of integrated coastal management plan. This is a policy statement which speaks in detail different aspects relating to coastal system management. It involves holistic forecasting about rise of sea level and its impact on us. Integrated management involves creating, maintaining and upgrading the coastal areas in line with economic needs, disaster prospects, health and safety, tourism etc. Next,

the proposition of community ownership is proposed by the researcher. This involves earmarking the local community as the owner of its surroundings and providing them the rights to use and conserve the resources in the ways and manners they have been doing for generations. This works on the principle that the local community is equipped with the traditional knowledge and the awareness of local customs. They have been living in harmony with the environment for generations and their intra family transferred knowledge is specialized to the localized environment which cannot be replicated by outsiders. Therefore, they are better equipped to manage sea level rise in an effective manner as they can apply their traditional knowledge in taking up effective steps such as reducing emissions etc. The research supports building of strategic infrastructures which have the potential of managing ocean rises. It includes building up of strategic dams, run off the river projects etc. The researcher proposes that these strategic infrastructures have to be strategically planned. There has to be careful planning for these structures involving their financial, technical and legal due diligence. This infrastructure should be those which minimally alter the natural ecology. The Northern European Enclosure Dam (NEED) is an ambitious project which involve building up of a project

enclosing North Sea so that the increased water levels can be suitably re-channelized and their flow be pass on to deficit areas instead of flooding the heavily urbanized European nations (DEFRA, 2006). The most important strategy is to reduce the level of global warming. This involves limiting the amount of carbon emissions both at national and at international level. There has to be active international collaborations to achieve this objective and they have to be mandatorily pursued. The Paris Agreement is a landmark achievement in this, however there has to be careful monitoring of actions that are being taken by the parties so as to really achieve the desired objectives. The efforts made to achieve the Nationally Determined Contributions declared pursuant to the Paris Agreement must be closely aligned with the obligations under other agreements such as Montreal Protocol, Kigali Amendment, Stockholm Convention, Rotterdam Convention, Basel Convention etc (Cazenave & Llovel, 2010). These efforts then must embolden the objectives of the major international bodies such as WWF, TRAFFIC, IUCN, UNEP, WMO, IPCC etc.

### CONCLUSION

The world is warming up and this is causing the sea level to rise up. Such sea level rise can create havoc which can be detrimental for the survival of humanity. This research tried

to understand the concept of this sea level rise, the causes of this rise and the what could be the possible solutions to deal with it. While Sea Level Rise is a real phenomenon, it requires dedicated national and international efforts to try to control the situation. While detrimental effect has been done, coordinated efforts can aim at restricting its overall impact in the long term. These are necessary to maintain the overall environmental stability and ecological development which are a must to ensure the survival on this planet.

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